McGraw-Hill
Publishing Company, Inc.
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American Machinist

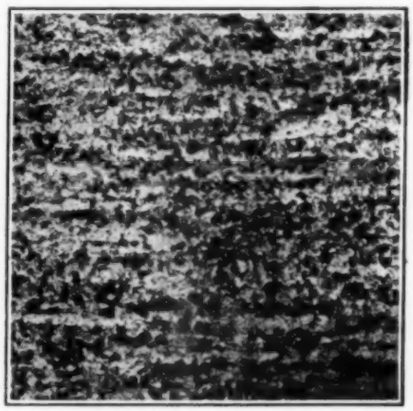
Editors
Kenneth H. Condit
Fred H. Colvin

Volume 68 | New York, April 26, 1928 | Number 17

Heat-Treating Bevel Gears

By C. S. Morgan
Metallurgist, Chandler-Cleveland Motors Corporation

IN THE manufacture of gears for an automobile, probably no gear presents as many problems, nor requires more care, special machinery and rigid inspection in its production than the rear axle ring gear. The machinery used by the different shops in manufacturing ring gears is all about the same, but the material and methods used vary considerably. The method to be described is used by the Chandler-Cleveland Motors Corporation. The material used is a special S.A.E. 2315 steel, having 3.25 to 3.75 per cent nickel and 0.30 to 0.60 manganese. It is special in that the carbon is limited between 0.15 and 0.20 per cent whereas the ordinary S.A.E. 2315 steel contains carbon from 0.10 to 0.20 per cent. Carbon is specified within these narrow limits since a 3½ per cent nickel steel is usually banded; that is, the carbon-free iron (ferrite) and the material containing the carbon (pearlite and sorbite) segregate into parallel bands. It has been found that when the carbon content is below approximately 0.13 or 0.14 per cent, there is considerable tearing of the tooth surfaces when cutting on the Gleason gear generators. This effect is probably due to some of the metal balling up on the edge of the cutter blade as it passes over the wide expanse of soft carbon-free iron. Increasing the carbon content cuts down the area of free ferrite and increases the areas of pearlite and sorbite, thus overcoming the tearing action. Fig. 1 shows a sample of steel with carbon content below 0.14 per cent that was heavily banded after normalizing and tore badly on the gear cutters.



Magnification 65 times

Fig. 1—Banded structure of normalized 3½ per cent nickel steel having less than 0.14 per cent carbon

In the forging of these gears the first step in the process is checking the steel that the forge shop will use. This is accomplished by requiring the steel mill to submit samples of the forging bars for approval before the steel is shipped to the forge shop. The submitted samples are carefully checked for chemical analysis and are given an Ehn carburizing test for "normality." The usual procedure in making an Ehn test is to carburize a sample at a temperature high enough to produce a hypereutectoid zone in the case, to cool slowly, and after polishing and etching, to interpret the resulting structure as to normality. This test is in its infancy and there are no widely accepted standards to follow. Each metallurgist follows his own experience and chooses those structures that he has found to be corelated to desirable physical properties. Different degrees of normality seem to be desirable for different purposes, such as the one to be described,

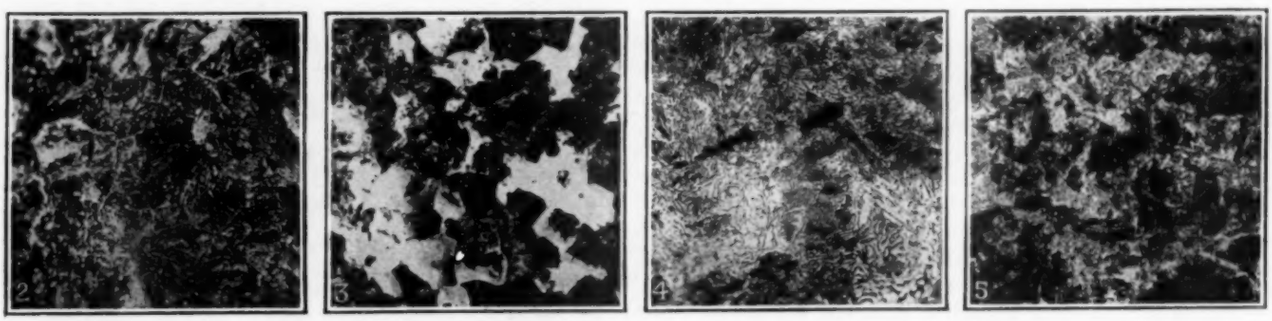


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Fig. 2—Normal 3½ per cent nickel steel with free cementite structure and large grain size. Fig. 3—Abnormal 3½ per cent nickel steel with free cementite in globular form. Fig. 4—Abnormal plain carbon steel that showed soft spots after quenching in water. Fig. 5—Partly abnormal 3½ per cent nickel steel that was used successfully

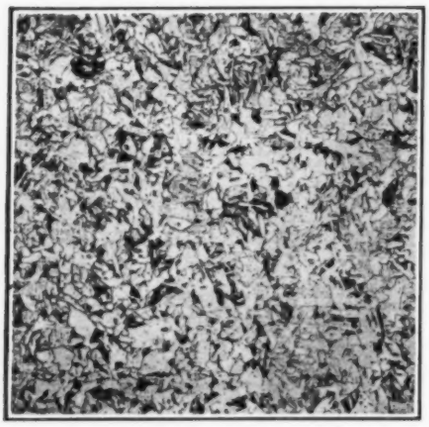

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Fig. 6 — Representative sample of 3½ per cent nickel steel after normalizing at 1,700 deg. F.

and while some rate normality from the grain size, others consider the condition of the excess cementite as more important. This explanation is made as the author does not wish to recommend any procedure or structure, but rather to report as a matter of interest the method he is following. It is altogether probable that as time goes on and the knowledge of the meaning of this test increases, the present method will be superceded by an improved one. Likewise different structures may be found more desirable. The procedure at the Chandler-Cleveland Motors Corporation is to carburize a sample at 1,700 deg. F. for eight hours and allow it to cool in the box. The sample is then polished, etched with a 5 per cent solution of nitric acid in alcohol, and examined at magnifications of 100 and 400 times. Interpretation of the structure of steel for use in ring gears is made mainly from the condition of the free cementite in the hypereuctectoid zone of the case. Fig. 2 shows a steel almost perfectly normal as is evidenced by the free cementite structure of the case being uniform, fine lined and sharply defined. Also, the grain size is fairly large. In Fig. 3 is shown a steel that is considerably abnormal. The free cementite is irregular, occurring partly in globules. It is also interesting to note that it was necessary to carburize this sample at 1,800 deg. F. instead of 1,700 deg. in order to produce a hypereuctectoid zone in the case, although a sample of another steel lying next to it in the same box showed a good hypereuctectoid zone at 1,700 degrees.

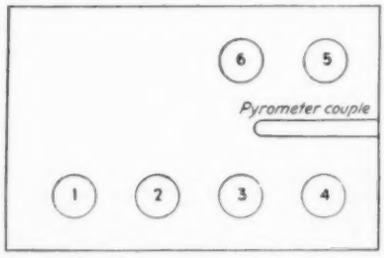


Fig. 8—Diagram showing placement of gear rings in furnace prior to quenching

The degree of abnormality found in 3½ per cent nickel steel by the author apparently does not affect the hardening qualities after carburizing to an amount measurable by ordinary methods. In plain carbon steel, however, abnormality manifests itself in soft spots after the piece has been carburized and hardened in the usual way. Fig. 4 shows a plain, carbon steel that showed soft spots after quenching in water from various temperatures up to 1,650 deg. These soft spots were only overcome by quenching in a salt brine after heating in a cyanide bath.

In all steels the normality seems to bear a relation to the impact strength. The more normal steels have less impact strength than the abnormal. For many ring gears, therefore, partly abnormal steels are preferred to the strictly normal ones. In Fig. 5 is shown one steel of this class that was used successfully in ring gears.

It has also been reported that the abnormal steels warp considerably more in hardening than the normal steels and while the author has found some evidence of this, it has not been definitely proved to his satisfaction.

Ring gear forgings are made either from flat stock (8 in. wide by 1⅛ in. thick being a common size) or from sections cut off billets. In the latter case the ring gears are formed like a pancake. This type is usually called "upset," although the gears frequently are made on a hammer rather than on an upsetting machine. The result is that the "grain flow" is uniformly radial. With the method of using flat stock, one line through the center of the gear is parallel to the direction of rolling of the original bar, while a second center line at a right angle to the first is transverse to the direction of rolling. It has been determined by various tests that the impact strength of teeth of finished gears is more uniform in the upset type than the flat forged type. This result is due to the fact that the impact strength of the teeth at right angles to the direction of rolling is less than that of the teeth parallel to the direction of rolling. It has also been reported that the warpage that takes place in carburizing and hardening is less and more uniform on the upset gears than on the flat-forged type.

At the present time there seems to be more flat-forged gears used than upset ones, although the trend is strongly in the direction of wider usage of upset gears. The choice of forging method depends to a considerable extent upon the design of the automobile rear axle, since the upset gears are somewhat more costly at the present time. If the axle is not designed with a large enough margin of safety, it will be desirable to obtain the advantage of increased impact strength that can be gained from upset forgings. In the plant being described both types are used quite successfully. The forgings are pickled when received, and as a first operation are inspected for dimensions, forging and steel defects. There is an allowance of $\frac{3}{32}$ in. of stock per side, exclusive of draft, for finish to insure that all scale pits and decarburized surface will be cleaned off in machining. After the forgings pass the rough inspection they are normalized at 1,700 deg. F. It takes approximately three hours to bring a furnace load of gears to heat, and after being held at heat for one hour, the gears are withdrawn and allowed to air cool. A considerable amount of work and experimenting has been done with several annealing and normalizing cycles, with various

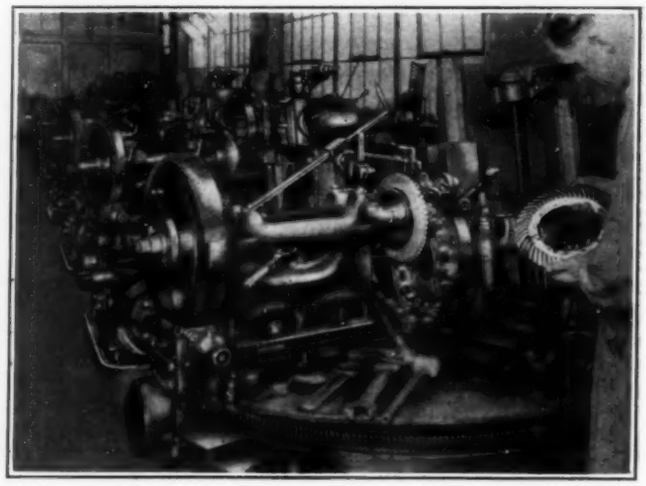


Fig. 7—Battery of Gleason spiral bevel gear generators

temperatures and rates of cooling, from a slow furnace cool to an oil quench followed by a draw, but it has been found that normalizing at 1,700 deg. produces the best general results. After this treatment the Brinell hardness is usually 149 to 163, and the steel is in the sorbitic state. Fig. 6 shows a representative sample after being normalized. After the normalizing treatment, the blanks are shot blasted free of scale and sent to the machine department.

The machining methods are quite ordinary, the operations being as follows:

1. Bore, turn and face one side on a Hartness automatic.
2. Ream center hole on Cincinnati drill press.
3. Face back face on Reed lathe.
4. Drill twelve rivet holes on Natco drill press.
6. Turn bevel sides on Fay automatic.
7. Grind back face on Walker surface grinder.
8. Rough cut teeth on Gleason gear generator.
9. Finish cut teeth on Gleason gear generator.
10. File burrs.
11. Test for noise and tooth bearing against master pinion.
12. Stamp date and trade mark.

After being turned, the blanks are inspected for runout on the back face, outside diameter, and bevel face in relation to the bore. Runout on the outside diameter and on the bevel face in relation to the bore is held within 0.002 in., while the back face is held within a limit of 0.001 inch. After the gears are cut and inspected, they are thoroughly washed to remove all oil and red

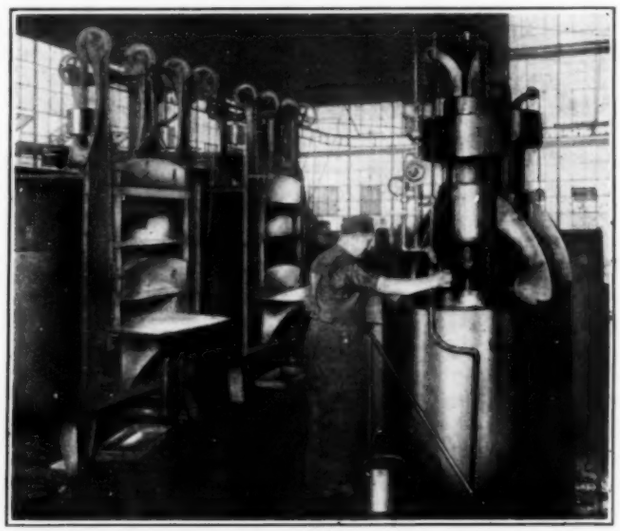
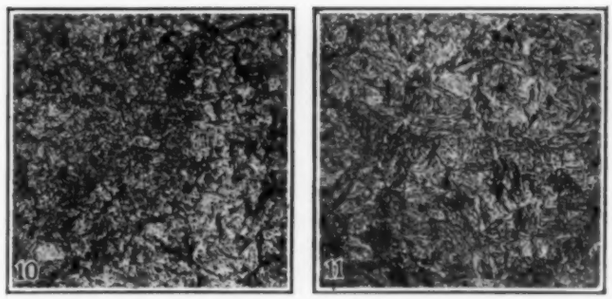


Fig. 9—Gleason hardening press being supplied from oil-fired furnaces

lead, and then placed in partitioned wooden boxes to prevent damage from nicking during transportation to the heat-treat department. Fig. 7 shows the Gleason gear generators. The utmost precaution is taken while handling the gears at all operations to prevent them from becoming nicked.

In the hardening room two gears are placed back to back and packed in flue-type boxes. Packing the gears back to back, prevents any great amount of carbon penetrating the back of the gear and also economizes on space, it being possible to pack eight gears in a box 14 in. high.

The gears are carburized for eight hours in oil-fired furnaces at 1,625 to 1,675 deg. F. This figure includes



Magnification 200 times

Fig. 10—Hypereutectoid zone of a hardened gear
Fig. 11—Hypoeutectoid zone of a hardened gear

the time consumed in bringing the boxes to heat. A case of $\frac{1}{32}$ in. with a carbon content of 0.80 to 0.90 per cent is produced. Half-inch test pieces with wires attached are packed in two boxes of each heat, and the test pieces are pulled out, hardened and broken to check the depth of case before the heat itself is withdrawn. The gears are allowed to cool in the box until black. This cooling takes from four to five hours. After unpacking the gears are dipped in a 10 per cent solution of hydrochloric acid and heated in oil-fired furnaces. This acid dip greatly retards the formation of scale during hardening. The gears are placed in the furnace as in the diagram, Fig. 8. Number 6 is pulled and quenched under the Gleason press, after which the gears in the furnace are moved up one notch and a new gear put in the place left vacant by No. 1. This procedure gives all the gears a uniform heating cycle, and a gear is usually hardened every six minutes. One operator can handle two furnaces and presses and can produce 200 gears per day. The quenching temperature is held at 1,375 to 1,400 deg. F. They will harden at considerably lower temperatures but this high temperature produces considerable refinement of the core, and produces no appreciable grain growth in the case. Others prefer a higher hardening temperature for the production of higher impact strength; however, maximum potential impact strength is not required for our designs, and the best results for this particular product, when considering minimum distortion, minimum wear and maximum impact strength, are obtained by the treatment described. Fig. 9 shows the Gleason hardening press.

Single Quench Preferred

A double quench would undoubtedly produce a tougher gear, but we prefer to use a gear of such size that it has ample strength and toughness after only a single quench, as the extra toughness gained by the double quench would not offset the increased distortion. Fig. 10 shows the hypereuctectoid zone of the hardened gear, while Fig. 11 shows the hypoeuctectoid zone.

After the gears are hardened they are drawn in a salt bath at 360 to 400 deg. F. for 20 minutes. The salt bath can be seen to the right in Fig. 12. The gears are next wire brushed free of scale and inspected for warpage in the hardening room. This check is made by placing the back of the gear on a surface plate and pushing feeler gages under the gear until the maximum runout is determined. Any gear that runs out more than 0.0025 in. on the back face is rejected here and run over. The rejections from this source are very small. The bore is also checked for out of roundness, and is held within a limit of 0.002 in. Very little trouble is experienced in holding this dimension. The gears are now sent to the grinding

department, where the bores are ground on a Bryant grinder equipped with a three-jaw air chuck. After the gear is placed in the chuck it is trued up to run within 0.0025 in., both on the bore and the back face. Any gears that cannot be trued up within these limits are sent back to the hardening room to be rehardened. Only the bore of the gear is ground. When the gear is cut the locating is done from the back face, and it has been determined that more quiet running gears are obtained by omitting the grind on the back face. It was found that the gear runs in a car more exactly to the position in which it was cut, than it would if the back face was ground. For this reason it seems desirable to eliminate the grinding of the bore, if possible, and experimentation with this end in view is in process. While many gears that are satisfactory without grinding have been produced, there is a certain amount of shrinkage on some that we have not been able to control.

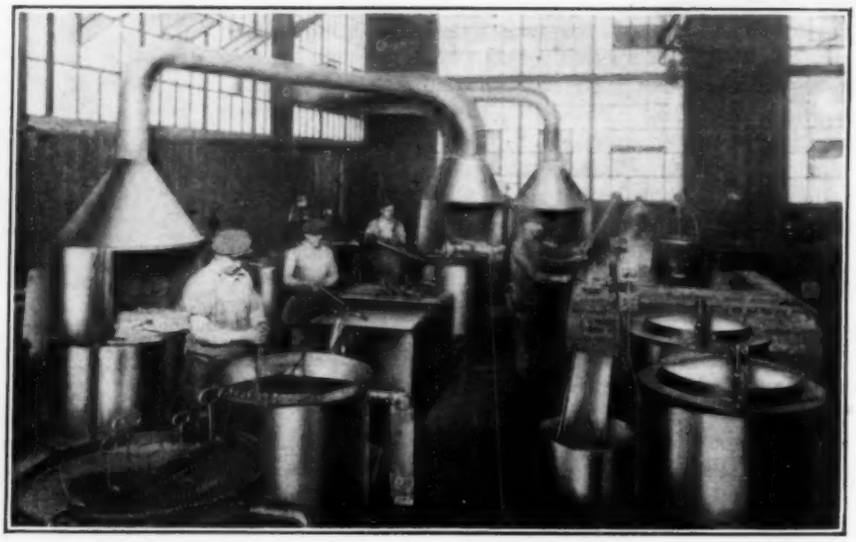


Fig. 12—After the gears are hardened they are drawn in a salt bath at 360-400 deg. F. for 20 minutes. The salt bath can be seen at the right in this view of heat-treating department, showing the general arrangement

After the gears are ground they are sent to the final test and lapping room, which is partitioned off to eliminate the usual shop noises. The gears are mounted in the test machines and run with some regular production pinions to insure that they have the proper bearing and sound. With these test machines it is possible to put varying loads on both the drive and drift side of the gear. After the ring gear and pinion are matched up they are lapped with flour of emery on Gleason lapping machines in order to produce a gear of maximum initial quietness. The ring gear is next fastened to the differential case and again inspected for runout on the back face and the outside diameter. These dimensions must be held within 0.0035 in. The pinion that was matched with the ring gear is wired to the case to prevent loss.

The Problem of Terminology in Management Research

By Ordway Tead

THE problem of terminology arises in management research for two reasons which were brought out by the author at the second technical meeting of the Institute of Management, American Management Association, New York, on Feb. 6. There is the difficulty of agreeing upon and delimiting bodies of facts to be analyzed; and there is the problem of being sure that the vocabulary is a widely intelligible one. It would be possible for every research project to start out with new and arbitrarily formulated definitions specified as applying only to the project in hand. But such arbitrariness means that comparison of data among students becomes thereby more difficult. Also, just so long as the vocabulary of each project is unique to itself the possibility of building up a self-consistent and universal science of management and management research becomes more difficult and the more delayed.

A good definition in the management field is one which has been arrived at by the conscious application of the scientific method. Certain well-defined steps comprise such a method to be pursued in composing a definition.

1. Recognition of the problem: Strict delimitation of the problem and its name can only come well toward the end and not at the beginning of the defining process.

2. Accumulation of facts: A certain amount of tolerance is required in this process because what facts are relevant, is necessarily somewhat obscure. There is danger that the researcher will (a) see only what he has been taught to look for; (b) see only what he wants to see; (c) fail to see items and meanings that are outside his experience. What facts he will discover is a highly relative and crucial problem.

3. Classification of facts: Here the requirement is that one can identify similarities and dissimilarities. Facts must be classified with the same degree of psychological insight as is required in collecting them. Wise classification also often helps to suggest the real meaning.

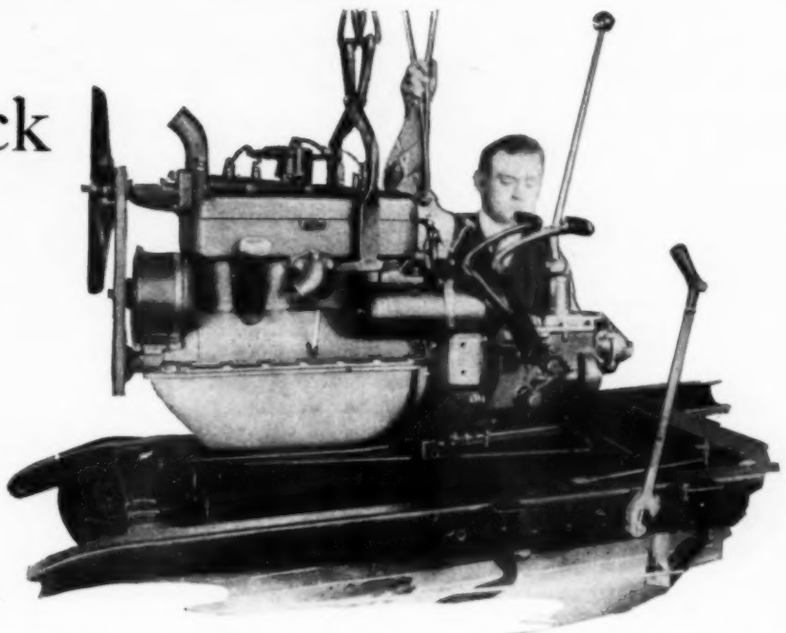
4. Formulation of hypotheses: In relation to this discussion the hypothesis is the new and tentatively formulated definition. It is important from the scientific point of view to realize that a definition is a hypothesis. It is a name for a given body of data. But it is valuable, significant and accurate as a name only as the fact data remain reasonably identical. A definition is thus a shorthand description of moving realities. It is a hypothesis in this sense of having always to be put to the test of seeing that the facts and the name we are using tie together in our own and others' experience.

5. Testing of hypotheses: Testing of a word or phrase might be accomplished by a nation-wide questionnaire to ascertain its usage among the majority of executives.

6. Tentative adoption of conclusion: The final step of assuring acceptance for a definition is, under present conditions, as difficult as any. In the absence of anything approaching a National Institute of Management Terminology, the need is clear for a great deal of toleration and patience. Constant discussion of experience, friendly criticism, and tentative offering by individuals and societies of new names for newly discovered bodies of fact—these are essential requirements.

Equipment Makes Possible the Ford Model A

Cylinder Block and Head Operations



By Fay Leone Faurote, M.E.

THE Ford Model A engine has four cylinders cast en bloc. As will be seen from the illustration, Fig. 1, it is a rather complicated casting. In fact the main cylinder block drawing carries twelve different views which will require careful study if the internal structure is to be thoroughly understood. The cylinders are, of course, vertical and have a bore of $3\frac{7}{8}$ in. and a stroke of $4\frac{1}{4}$ in. The rated horsepower, according to the S.A.E. standard, is 24.03, although the maximum horsepower developed at 2,200 r.p.m. is 40. The piston displacement is 200.5 cu.in. and the compression ratio is 80 gage. As in the case of the former model an "L" head is used, which, like that of its predecessor, is also detachable. The head is shown in Fig. 2. The upper half of the crank case is cast integrally with the cylinders while the lower half, or oil pan, Fig. 3, is of pressed steel.

The machining of the cylinder block requires 56 operations. Sixteen of these are performed by hand, the others on machines. The long-time operations on milling machines on the Ford Model T were performed on types having long tables. The Model A cylinder blocks are milled on Ingersoll drum type continuous milling machines. Production is at the rate of 42 units per hour. In Figs. 4 and 5 are shown two of these units.

After the locating spots are cut on a two-spindle machine, which will do 250 components an hr., the four-spindle rotary milling machines receive the blocks and mill off top and bottom, doing 42 an hr. The six main-bearing bolt holes, four $\frac{5}{8}$-in. water holes, and four $\frac{1}{4}$-in. steam holes are next drilled on a fourteen-spindle Foote-Burt inverted drill at the rate of 25 per hr. Then the 2,505-in. holes are reamed on a special Ford two-spindle drill which will do 200 an hour.

A special Moline four-spindle boring machine with piloted boring bars, next rough-bores the cylinders at the rate of 28 per hr. An eight-spindle rotary and a six-spindle rotary milling machine mills the sides and ends at the rate of 110 to 150, respectively. The main bearings are roughed out in a three-spindle Ingersoll planer type milling machine which will do 80 blocks an hour.

With a production of 158 per hr., a 20-in. single-spindle drill, with a special spindle nose, then spotfaces the main bearing bolt holes.

This is followed by a rough water test on a specially designed Ford water testing fixture that will handle 150 blocks an hr. The three succeeding operations straddle mill the main bearings and rough finish mill the oil slinger groove. These operations are performed on special Ford machines.

After the fifteenth operation, which is to line ream the main bearings and oil retainer diameter, the bearings are inspected and the work sounded for cracks. After this hand operation a four-spindle Moline boring machine with piloted boring bars, completes 24 units an hr., and a four-spindle Foote-Burt reaming machine, handling 26 per hr., semi-finish reams and finish reams and chamfer bores, after which there is another inspection.

The valve seat holes are then bored, the valve stem holes spotted, and the valve stem and pushrod holes drilled on a Foote-Burt sixteen-spindle drill which passes work through at the rate of 17 blocks per hour.

The twentieth operation is: Spotface for valve bushing and valve chamber. This is performed on an eight-spindle drill at the rate of 95 an hr. The valve stem and pushrod holes are then semi-reamed, after which a sixteen-spindle drill, handling 78 components an hr., counterbores the valve seat holes and finish reams the valve stem and pushrod holes, after which there is another inspection.

A special Ford turning and facing machine, which handles two castings at a time at the rate of 20 per hr., turns the transmission end. This is followed by an

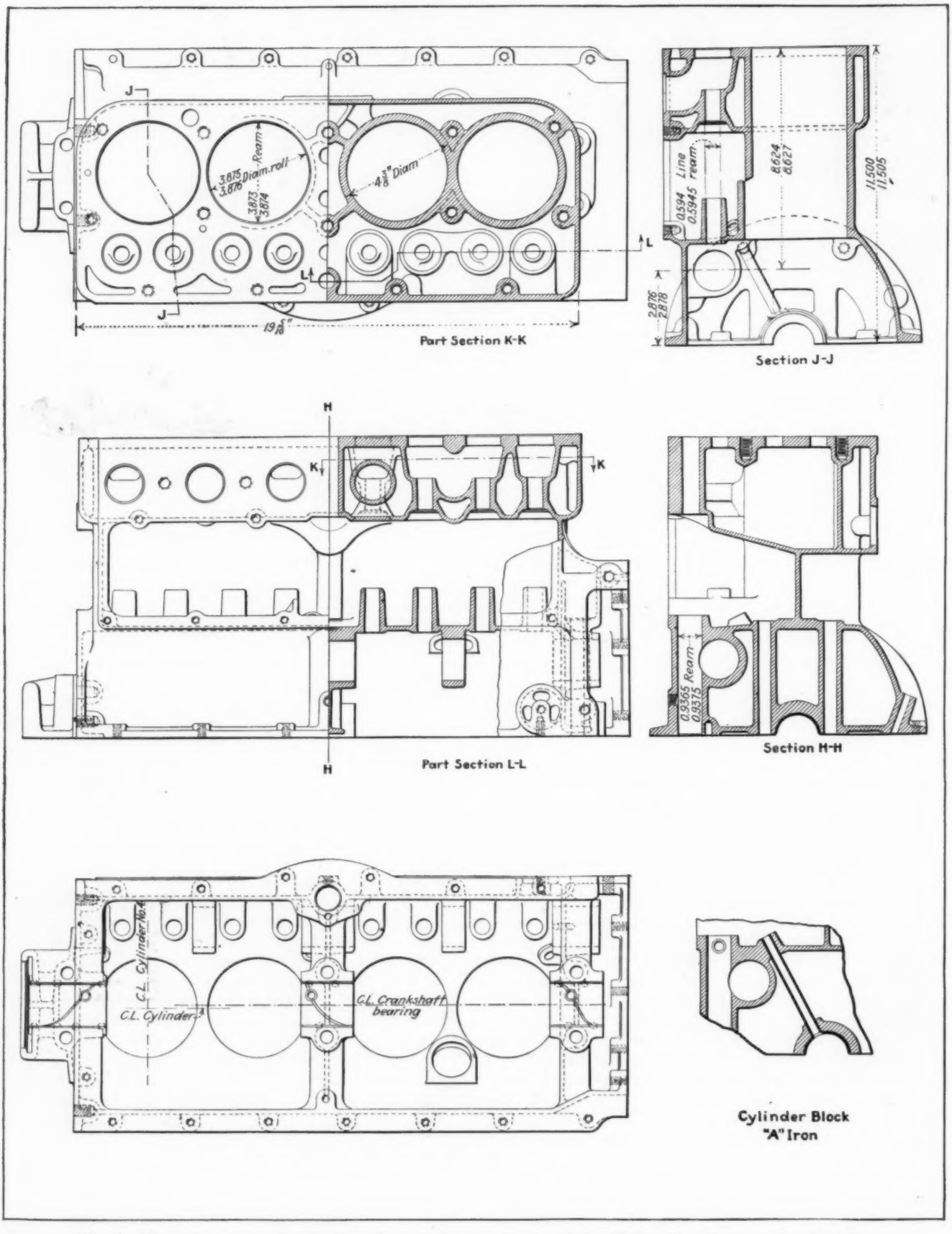


Fig. 1—Plan, elevation and several sections of the new Ford cylinder block. The block casting includes the upper half of the crankcase. Note the oil tube in Sections J-J and N-N

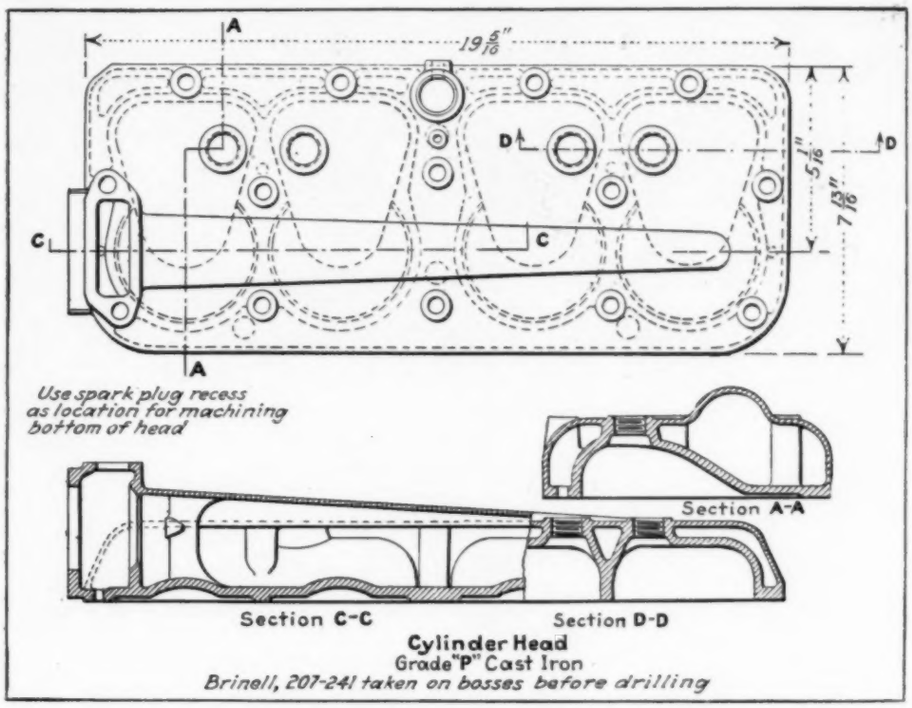


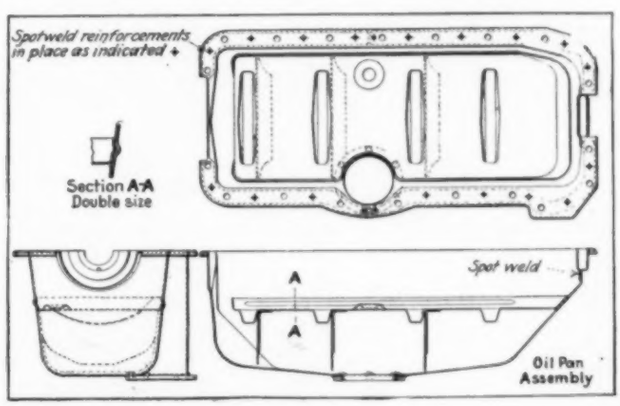
Fig. 2 (Left)—The cylinder head casting for the Ford Model A differs radically from the one used on its predecessor. The spark plug holes are located above the inlet valves and the combustion chamber is designed to give maximum turbulence to the incoming charge. A study of the sections shown will bring out the care taken to provide ample cooling water circulation

Fig. 3 (Below)—The lower half of the crankcase, or oil pan, is a drawn steel unit reinforced around the flange by a steel strip, spot welded in place, to aid in forming an oil-tight joint when the bolts are taken up. Troughs hold oil supplies in which the connecting rods dip

Cylinder Block Operation Sheet

No.	Operations	Machines	No. per Hr
32	Drill oil filler and oil gage hole	21-in. Cincinnati drill, with 2-spindle head	75
33	Ream oil filler hole	21-in. single-spindle Cincinnati drill	125
33-A	Drill 21/64-in. hole thru shell in line with oil pipe, drill (ream) oil pipe (temporary operation)	21-in. single-spindle Cincinnati drill	35
33-B	Tap and insert ¼-in. pipe plug (temporary operation)	Hand operation	...
33-C	Spotface ¼ pipe plug (temporary operation)	21-in. single-spindle Cincinnati drill	50
34	Drill oil pipe holes to main bearings	20-in., 3-spindle Cincinnati drill	45
		No. 2 3-spindle Avey drill	40
35	Drill anchor holes in main bearings	13-spindle Foote-Burt drill	175
36	Spotface cam shaft thrust bearing boss	24-in. single-spindle Cincinnati drill	100
37	Drill distributor holes	24-in. 3-spindle Sibley drill	50
38	Spotface distributor holes	21-in. single-spindle Cincinnati drill, special offset head	150
39	Ream distributor hole	24-in. single-spindle Sibley drill	100
40	Assemble oil pipe to main bearings and distributor hole	Hand operation	...
41	Brush and blow out dirt from main bearings	Hand airline	...
42	Inspect	Hand operation	...
43	Babbitt bearings	Hand operation	75
44	Mill gates from bearing	Ford chamfering machine	300
45	Remove excess Babbitt	Hand operation	...
46	Peen bearings, three at a time	Special pneumatic hammers, hand	...
47	Inspect bearings	Hand operation	...
48	Burnish piston holes	4-spindle Foote-Burt boring machines, 4-spindle Hutto reciprocating grinder (used for experimental work)	250
49	Tap (14) 5/16-in. holes in bottom (2) 7/16-14 in water connection side, (11) 5/16-18, (6) 7/16-14, (1) ⅛-in. pipe tap hole in valve side	3-way Foote-Burt, 24-spindle tapping machine	200
50	Tap top and ends (14) 7/16-14 holes top, (4) ⅜-16 holes in front and (6) 7/16-14 holes in rear	24-spindle Foote-Burt tapping machine	150
51	Wash	Ford special washer	375
52	Final inspection bore and holes	Hand operation	...
53	Blow out dirt from tap holes	Hand operation, airline	...
54	Final inspection	Hand operation	...
55	Final water test	Water test fixture	95
56	Ream 2 dowel holes in transmission end	Ford machine for reaming two 0.4360-in. transmission locating holes	125

Operations 46 and 49 are illustrated in Figs. 6 and 7, respectively.



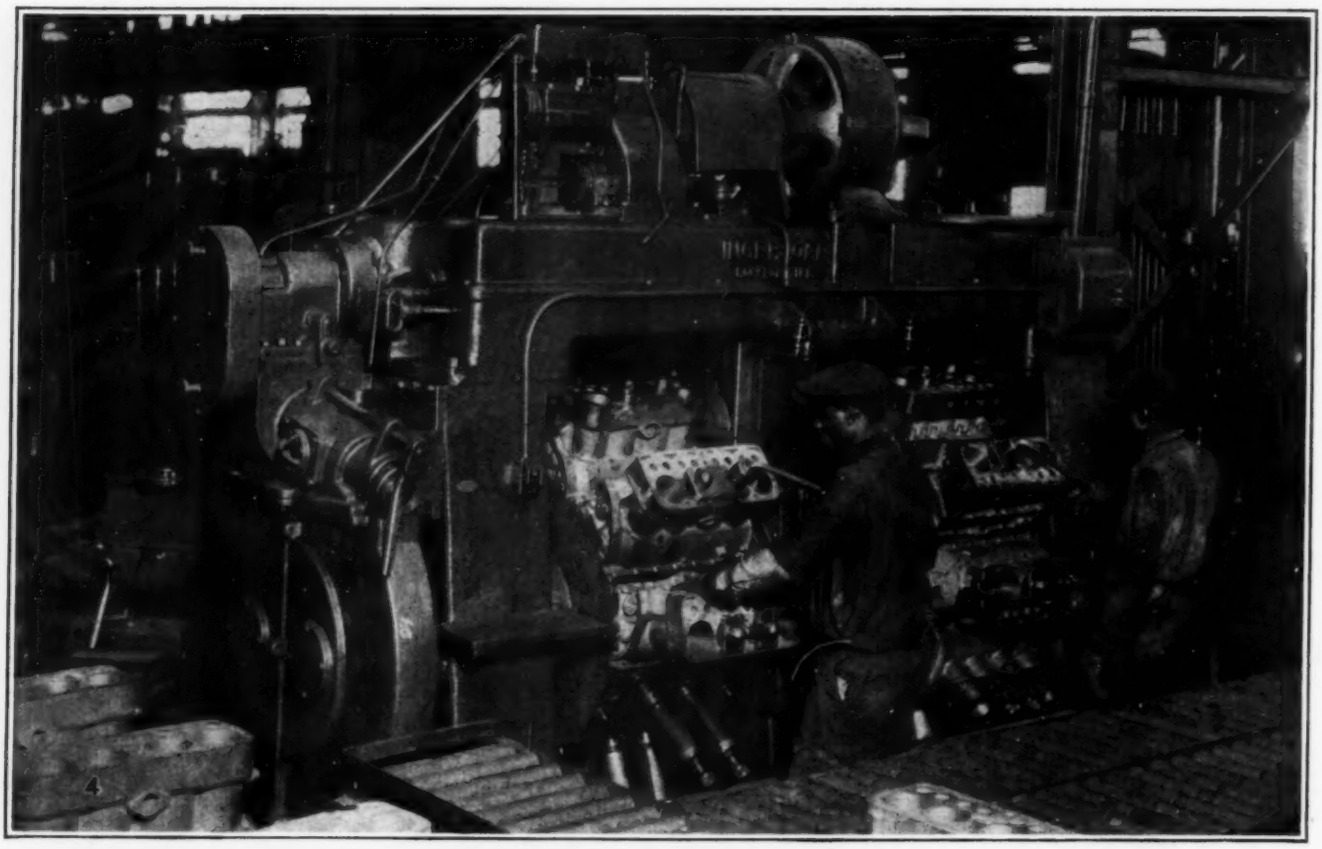


Fig. 4—Facing the timing gear case and transmission case ends of the cylinder block. Machines of the drum type, as shown in the illustration, have replaced many of the table-type machines used on the old Model T engines. Details of the fixture are evident; two dowels in the base for locating, and simple lugs with slotted openings for holding down. The large spacers on the hold-down bolts are rounded off to permit easy entry into the cylinder bores

Fig. 5 — Another drum-type milling machine for facing the top surface of the cylinder block, and the bottom surface, which forms the upper half of the crankcase joint. Some idea of the fixture design can be gained from close study of the illustration. Two nuts are sufficient to hold each block, on the right. Note the support given the light crankcase by the fixture on the left

Fig. 6—In the special machine shown here the main bearings are peened, all three at once, under pneumatic hammers. Counterweighting of the heavy swinging members, and ready accessibility of the clamping lever and control valve handle make the machine easy to manipulate and a rapid producer

Fig. 7—Typical of many of the drilling and tapping operations on Ford parts is the one shown. So-called "way" drilling and tapping machines have always found favor with the Ford production men. This particular one happens to be a Foote-Burt set up to tap 14 $\frac{7}{16}$-in. holes in the bottom of the block, 2 $\frac{7}{16}$-in. holes in the water-connection side, 11 $\frac{7}{16}$-in., 6 $\frac{7}{16}$-in. and 1 $\frac{1}{8}$-in. pipe holes in the valve side

Fig. 8—A general view of the cylinder head department showing a few of the machine tools and two types of conveyors

inspection. The camshaft bearing hole is then drilled. A two-spindle Hamilton drilling and boring machine, having a capacity of 20 per hr., is used for this operation. A special Ford two-way drilling machine is used for reaming after which there is another inspection.

As it has always been the practice of the Ford Motor Company to use two, three and four-way drills whenever possible the twenty-ninth operation, which calls for the drilling of fifteen $\frac{5}{16}$-18 tapped holes and one $\frac{9}{32}$ drill hole in the bottom, four $\frac{3}{8}$-16 tapped holes in the front end and six $\frac{7}{16}$-14 tapped holes and two 0.436 reamed holes in the rear end, is done on a twenty-six-spindle Greenlee three-way drill.

The three succeeding operations are drilling operations in Foote-Burt and Greenlee three- and four-way machines. At the end of these operations there is another general inspection of all drilled holes.

The succeeding 28 operations needed to finish the machining operations, testing and inspection of the cylinder blanks are as follows:

The cylinder head, illustrated in Fig. 2, which contains the upper part of the combustion space, carries the spark plug holes, a portion of the water jacket and the water pump housing, is made of grade "P" cast iron with a Brinell hardness of 207-241 (taken on bosses before drilling). It is a casting, roughly 20 in. long, 8 in. wide and $3\frac{3}{4}$ in. high. A general view of the cylinder head department is shown in Fig. 8. The two types of conveyors should be noted.

After casting, sixteen operations are necessary to finish it for assembly. Beginning with the spotting of four locating bosses, the second operation calls for the drilling of four spark plug holes, fourteen bolt holes, five steam holes, one $\frac{3}{32}$-in. hole, one $\frac{1}{4}$-in. hole, four water connection holes, one $2\frac{1}{16}$-in. hole and three $\frac{5}{8}$-in. holes, all of which are drilled at one time on a Foote-Burt 34-cylinder, three-way drilling machine, handling 25 cylinder heads per hour.

The bottom is then milled on a special Niles eight-spindle rotary milling machine capable of an output of 100 per hr. Then follow two other milling operations: first the water connection pad (top), done on a six-spindle Ingersoll, and the pump end on a two-spindle Niles rotary. The combustion chambers are then bored on a four-spindle special boring machine, which handles 100 per hour. All bosses are then spotfaced with a Foote-Burt drill. The next three operations are performed on a 21-in. Cincinnati drill and are, respectively: finish ream and chamfer water pump hole and ream distributor hole; ream 0.249/0.251 distributor dowel pin hole. The eleventh operation is also performed on a Cincinnati drill: drill and spotface $\frac{3}{8}$-24 tapped hole, which is done at the rate of 150 per hr. The twelfth operation results in the tapping of four spark plug holes and the four water connection holes, performed on a two-way Foote-Burt tapping machine at the rate of 150 per hr. The last machine operation is the tapping of a $\frac{3}{8}$-24 hole on a No. 2 Garvin tapper at the rate of 150 an hour. The parts are then washed by passing through a conveyor washer, giving a water test on a special Ford test fixture and finally inspected, after which they are ready for motor assembly.

WHEN they saw the new Ford automobile men said it could not be produced at the price listed. That remains to be seen. How the crankshaft, piston and piston pin, transmission case, rear axle, frame and gasoline tank are being made will be described in future articles. Modern equipment is playing its part in the undertaking.

Making Power or Buying It

YOUNG John Blackington had just come into control of his father's business. Blackington, Sr., had been forced to quit by a complete nervous breakdown and John found the responsibility of the whole works rather staggering for a young man. Being acquainted with Mr. Holland, a life-long friend of his father, he asked him to be kind enough to come in to talk things over.

"It may be nothing but stage fright, Mr. Holland, but there are several things I'm not quite easy about. We have a fair amount of orders on hand, but the engineer tells me the power plant needs a lot of work done to keep it up-to-date—and I don't see my way clear to investing a lot of money there when I'm likely to need it for other things."

"Just why should a plant of this kind bother with a power house, John?"

"That's what I've been asking dad for some time, Mr. Holland. It's been a sort of hobby of his, you know. He used to work where they built steam engines and he got a lot of kick out of having his own power plant."

"What do the books say the power costs you, John?"

"When dad figured it up we saved a lot of money making our own power. But that accountant we had last spring got in bad by trying to show dad he wasn't saving a cent. On top of that I don't feel like sinking capital in the power house. What do you think about it, Mr. Holland?"

"Son, I don't often give direct advice. I try to point out both sides of a problem and perhaps tell clients what others have done under what seemed to be similar circumstances. I don't want to spend your money but rather to show you how others have spent theirs and what happened to it."

"But should I repair the power plant or let it run as long as it will and then abandon it?"

"First let's talk about the cost of power. Mighty few shops of this size are making their own power today unless they have to use a lot of steam elsewhere in the plant. Either it doesn't pay or the electric power companies hypnotize the managers into believing it is cheaper to buy their power."

"That's what the accountant told dad, Mr. Holland."

"Then there's another thing to figure too, John. How much of your time can you save if you don't have to think about the power house. They do say your dad spent a lot of time on it, first and last."

"He sure did. If dad had counted his time as overhead on the power house cost, I don't believe he could have figured out any profit in it."

"Well, John, I guess you've answered that part of the problem yourself. But you are wondering whether to make the change now—or later. Isn't that it?"

"Yes, Mr. Holland, that's it. I feel it must be abandoned sooner or later."

"What do you do when you have an old car, John? Do you hang on to it as long as it will run—or do you sell it when you can get the best price for it? The cost of the new car isn't any more one time than another, you know."

"That's just another way of telling me to sell the old power plant when I can get the most for it, isn't it, Mr. Holland? I'll have to look about and see what the market is for power plant stuff, because you've backed up my idea as to buying power instead of making it."

"Guess you've hit the answer yourself, son. And I think you're right about the time the power house would take, that you ought to be devoting to other phases of the business. For you people are machinery builders and not power generators. That power plant may have taken the place of golf with your dad, but I don't believe it will with you."

Executives are invited to discuss the problem involved in the foregoing case. Accepted contributions will be paid for.

(Discussion of preceding problems follows on next page)

EXECUTIVE FORUM

Discussion

How Much Shall the Proprietor Draw in a Small Shop?

It depends upon conditions. I believe it impossible to answer the question directly. Is it not a matter of supply and demand that determines the amount of earnings anybody can make? Mr. Shepard should try to steer a course between too-high and too-low prices that will fill his shop with orders; then he should increase the charge successively, a little at a time, until orders begin to stop coming in, where he again will be compelled to lower his prices.

If Mr. Shepard cannot make ends meet that way, he will have to increase his earning power by working longer hours. I refuse to accept the notion that a man is capable of working only eight hours a day.

In his struggle Mr. Shepard should not forget that business conditions may be improved by advertising. —A. E. FRISTEDT, *Sweden.*

Setting Prices on Special Machines

The problem that Henry Harper was up against is one that has shown plenty of "red ink" for many manufacturers. The buyer dangles before the eyes of the manufacturer a possibility of a lot of future business but will only order one machine now, and the attempt is made, frequently successfully, to get the manufacturer to spread some of the fixed charges against machines he may never build.

The buyer usually realizes that there are certain charges applicable which have nothing to do with the quantity made. If he does not realize this he can be easily sold on this fact. This being the case why not segregate these charges and quote the buyer accordingly, as follows:

1—Make quotation on all necessary patterns.
2—Make quotation on all necessary special tools, jigs and fixtures.
3—Make quotation on necessary drawings, if any.

These quotations should state that the patterns, tools and drawings are the property of the buyer and deliverable on demand. In other words, the buyer gets something tangible for these three charges, which he can set up as an asset account or write off, or add to the machine cost, or distribute in any way he sees fit. It is his to do with as he pleases. Include in the tool charges the necessary special tools to make economically the maximum number the customer indicates he may order. Having by this method taken care of some of the large elements in the fixed charges, the difference in the unit cost between one and twelve units will of course be much less than if all these charges were added into the cost of the units without being segregated.

The other major charge is, of course, "set-up" time. All of this must be charged directly against the production of the number actually made in one lot. It cannot be widely distributed.

Then make up quotations on the machines themselves in lots of one, three, six and twelve, to be made in *one lot.* If the buyer has no immediate intention of buying twelve machines, he will probably come back with the complaint that the second item (tools) is too high, as he only wants one machine now. Then the price can be revised by figuring on laying out by hand instead of jigging, etc., so that the tool charges will be substantially reduced but the unit price for one materially increased, and it will be up to the buyer to make a decision. He has all the facts before him. Of course, if only one is ordered under the last proposition, a further tool charge will be necessary on every subsequent quantity ordered. —R. B. WEILER.

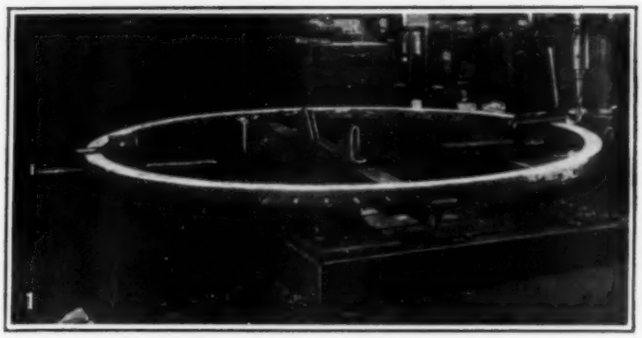
About Wage Incentives

Wage incentive systems are devised primarily for the benefit of the employer because he gains the most through increased production. This, of course, is as it should be. Workmen, however, generally regard the introduction of any new plan as something that will give the boss the best part of the bargain.

Let me relate, as Mr. Holland is wont to do, what happened to such a proposition when the head of a certain company put it up to the men.

It was the policy of this company to take a shop vote on matters concerning dealings between the management and the men in the shop. The proposition met with so much opposition that the company withdrew it. The bone of contention was a provision that called for a distribution of an extra bonus every three months.

The plan was fair and would have proved quite profitable to steady workers, but not to the floating element. Some of the men objected to waiting so long for this extra money and demanded it be given weekly instead of four times per year. The older men, being far sighted, saw the advantages of the plan and worked hard to bring about its adoption, but they were in the minority and the proposition was voted down. Later these poor sports admitted, after checking up on their earnings, that the proposed plan would have netted them more than they are now earning.
—SAMUEL KAUFFMAN.



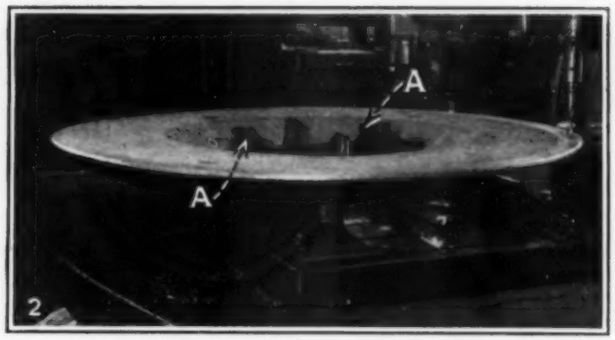


Fig. 1—Fixture for drilling smokebox rings. Fig. 2—Drilling the boiler front for a smokebox on the same fixture

Special Fixtures for Railroad-Shop Work

By Fred H. Colvin
Editor, American Machinist

FIRST cost is an important item in fixtures for railroad-shop work, for, generally, the number of pieces to be made is too small to permit distributing the cost of an expensive fixture so as to show a net saving. The fixtures illustrated were designed with this in view, yet they are efficient, easily handled, and have shown a substantial saving. They are from the Colonie Shops of the Delaware & Hudson Company.

The fixture shown in Fig. 1 is for drilling smokebox rings and boiler fronts for smoke boxes. The illustration shows the construction of the fixture with its four arms of T-bars mounted on a central pedestal that is attached to the bed plate of the radial drilling machine. The ends of the arms are turned up to prevent the work from slipping off while it is being located. The ring is held by straps pulled down by keys that go through the uprights, between the bent-down legs of the clamps and the inside of the ring. The clamps fit over the tops of the T-bars and hold the rings firmly in place. The four central arms are made of steel plate bent to form a central opening. For drilling the boiler fronts, the ring clamps are removed and the work is held by the central arms. Loops, or links, that fit over two opposite arms hold the front down, as in Fig. 2. The links, or clamps, are held by wedges fitting into cross holes in the central arms, as can be seen at *A*. The holes are drilled in the same way as in the ring, using previously laid-out drill centers.

The size of boiler fronts has outgrown the diameter of the boring mill table, so far as holding it in the usual manner is concerned. Fig. 3 shows how a specially-shaped clamp makes it easy to hold the front on a table of less diameter than the front itself. The clamps are very easily made, being single U-bends with one end fitting into the T-slot of the table and the other end carrying a setscrew that clamps the front to the table. These setscrews, it will be noticed, are at an angle that tends to draw the clamps into the table slots. The clamps are for holding the front while the center hole is being bored and its flange is being faced. In turning the outside, the front is held by central clamps. A pair of fixtures of a somewhat more elaborate nature can be seen in Fig. 4. They are for planing driving-box shoes and wedges where the large

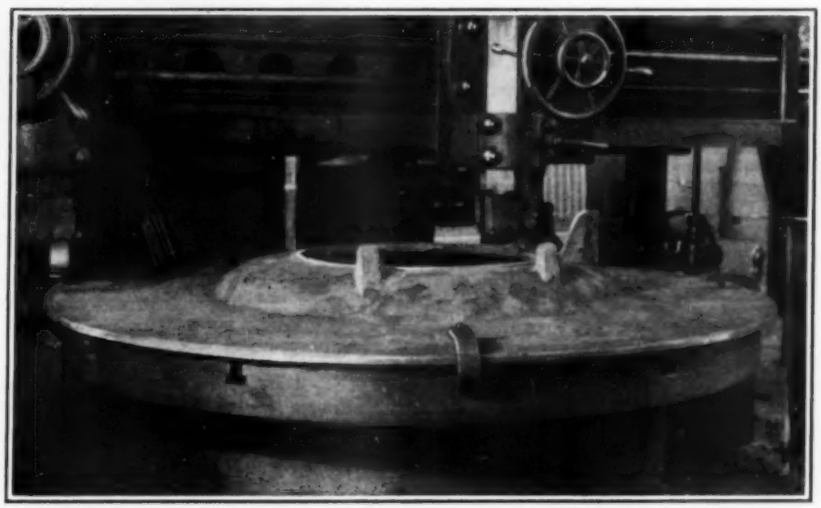


Fig. 3—Special clamps that hold a boiler front for a smokebox larger than the boring mill table, while the center hole is being bored and its flange faced. The outside is turned on the same machine, in which case the clamps are placed upon the metal surrounding the central opening

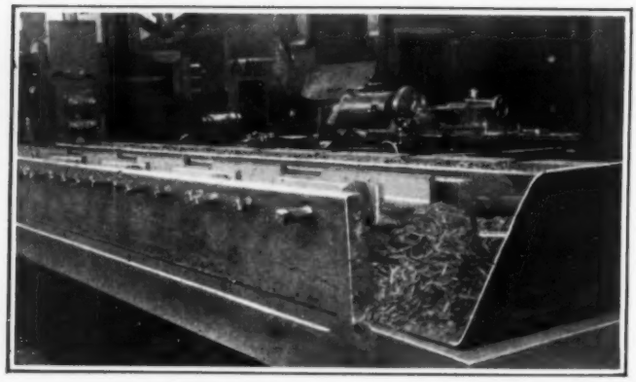


Fig. 4 — Long, string-fixture for machining driving-box shoes and wedges. Two fixtures are on the planer bed so as to utilize both heads on the cross-rail. The fixture holds all widths of shoes and wedges

Fig. 5 — Templet for laying out driving boxes for crown brasses and cellars. The templet rests in the equalizer pocket at the top of the box. Other templets to fit all styles of boxes are in the case at the back

quantity turned out justifies the making of more costly fixtures. These fixtures, are, however, very simple, consisting of long cast-iron blocks with channels in which the shoes and wedges are held for planing. The fixtures are designed for the largest shoes and wedges and filling blocks are used when smaller sizes are being machined. As can be seen, these fixtures hold a long string of either shoes or wedges that are planed at once. In the case of wedges, the tapers are secured by using suitable raising blocks under one end.

The method of laying out driving boxes for machining for the crown brass and cellar fit is shown in Fig. 5. The templet can be seen in place on the driving box. The upper part of the templet is a channel that rests on the spring hanger seat and locates it from that point. Similar templets are made for each style of driving box, and are kept in the case shown in the background. The case is placed so as to be convenient to the workman who does the laying out and machining. By having the templets close at hand, he can lay out one box while another is being machined.

More of the time saving devices of this shop will be shown in a later article.

Taking Chances—*Discussion*

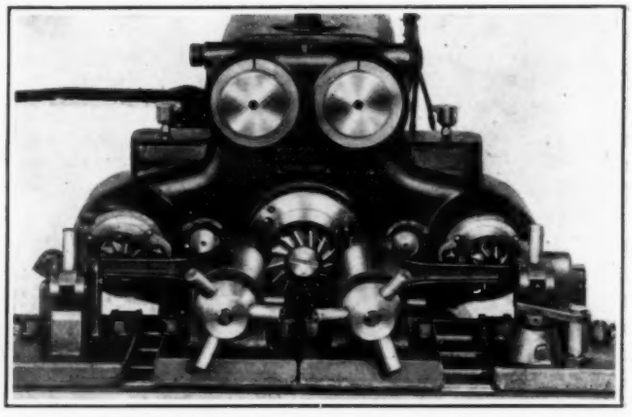
By J. T. Towlson

THE article by H. Maplethorpe an page 267, Vol. 68, of the *American Machinist,* has uncommon interest to an old-timer. When I was an apprentice between fifty and sixty years ago, inside and outside calipers were the only tools generally available for measurement. There is no doubt whatever that men in those days became most uncannily expert in the use of calipers. But, really, it was always a case of muddling through compared with the present micrometer. Admitting the value of the caliper, while recognizing its limitations in respect to mass production and universal interchangeability, I think that the advocates will agree that caliper measurement as close as 0.0002 in. are a little bit "too thin." I am inclined to agree that an inside caliper is more sensitive than an inside micrometer, but I must contend, also, that the caliper must be used by an expert, while the "mike" may be used successfully by a novice.

Reciprocating Fixture for Milling Connecting Rods

By George H. Feltner

A FIXTURE for milling the ends of connecting rod bosses is shown in the illustration. The operation is performed before drilling and boring so that the work can be located from these milled surfaces in subsequent operations. The bosses on one side of the rod at the left are machined, and the rod is then transferred to the right-hand section of the fixture for completion. The operation is handled in a No. 2 Milwaukee milling machine equipped with a three-spindle head arranged with two



Milling the bearing bosses of connecting rods on a three-spindle head milling machine

outer cutters to mill the bosses at the small ends of the rods, and a larger cutter at the center to machine the crankshaft bearing bosses of both rods.

With the fixture loaded as illustrated, the table is first moved to the right which causes the rod at the left to pass by the cutters, and then it is fed to the left to finish the other rod. One of the features of the fixture is that it is made in four sections, so that the sections can be so spaced on the table as to permit different lengths of rods to be machined.

The production is 50 pieces per hr., milled on both sides. This time includes the two settings necessary for the completion of the work on each rod.

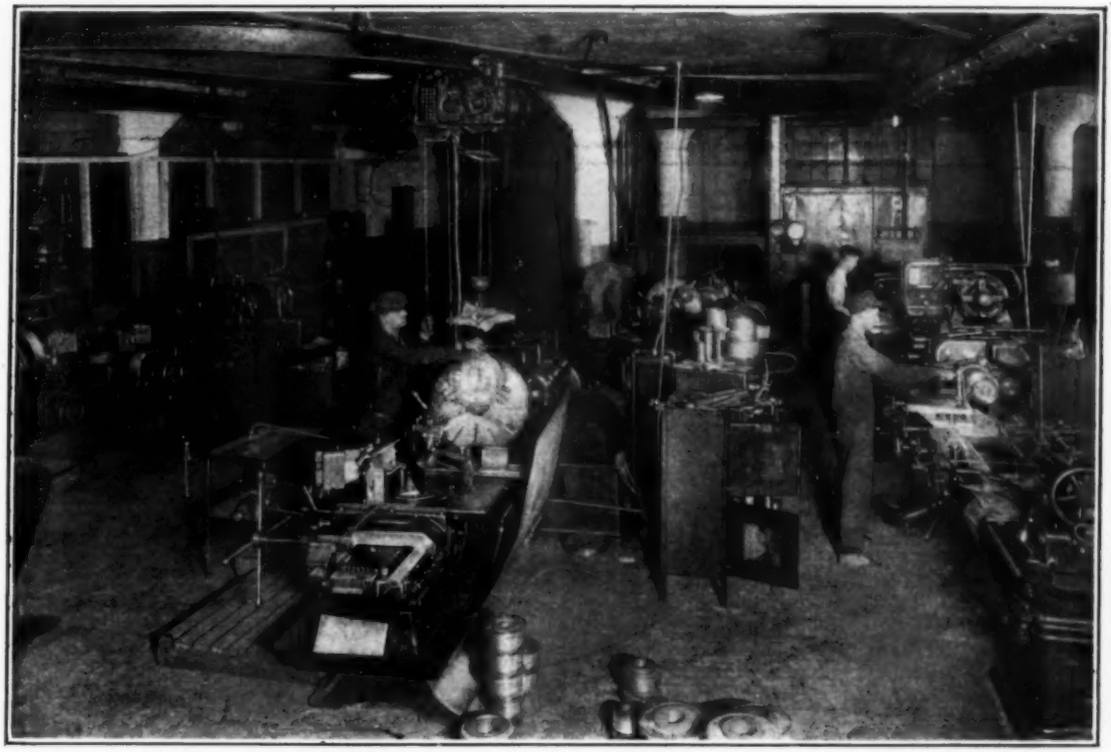


Fig. 1—A typical group of machines at the Homewood Renewal Parts Plant. All machines are motor driven, and electric power is supplied through overhead piping so that machines can be moved about readily

Making Replacement Parts Pay Their Own Way

An interview with E. C. BRANDT

Works Manager, Homewood Renewal Parts Plant, Westinghouse Electric & Manufacturing Company

REPLACEMENT parts' supply for old machines discontinued in manufacture is one of the big problems that every machine builder faces. The more progressive the plant is in advancing the designs and getting out improved machines, moreover, the greater may become this problem of supplying the customer with renewal parts at a reasonable cost figure. This problem is successfully solved at the plant of the Westinghouse Electric & Manufacturing Company by entirely divorcing replacement parts manufacture from the operations of the regular production shop, and placing it under a separate organization in a separate plant.

When designs have been modified so that a complete machine, a mechanism, or in some cases a part, has been discontinued in production manufacture, it is permanently assigned to the renewal parts plant, which is located at Homewood, several miles from the main production shops. In electric machinery, it is not at all unusual to find generators, motors, and other equipment in efficient operation after 20 to 40, or even more years of service, and the Homewood plant is, therefore, forced to keep itself prepared to meet orders for any one of 300,000 separate parts of discontinued machines. Original drawings and specifications of these parts, as turned over by the production shops, are kept on file, as are also the original tools in many cases. But as methods of manufacture are continuously improved from the original shop methods used, the problem of making the part when the order is received is always an open one, requiring progressive engineering. The old idea of subordinating replacement parts to haphazard manufacture as the necessity for supplying a certain part arose often led to large monetary losses on the sale of replacement parts, and also to the disorganization of shop routine.

The organization of the replacement parts renewal plant, and its relation to the main manufacturing plant, is shown in the accompanying chart, Fig. 2. The works manager in charge of the renewal parts manufacture comes under one of the vice-presidents, who co-ordinates the former's work with that of the executive heads of the main plant. It can be seen that general engineering data and the supply of raw material are obtained directly from the main plant. Cost price quotations on renewal parts are made to customers on a sliding scale, based

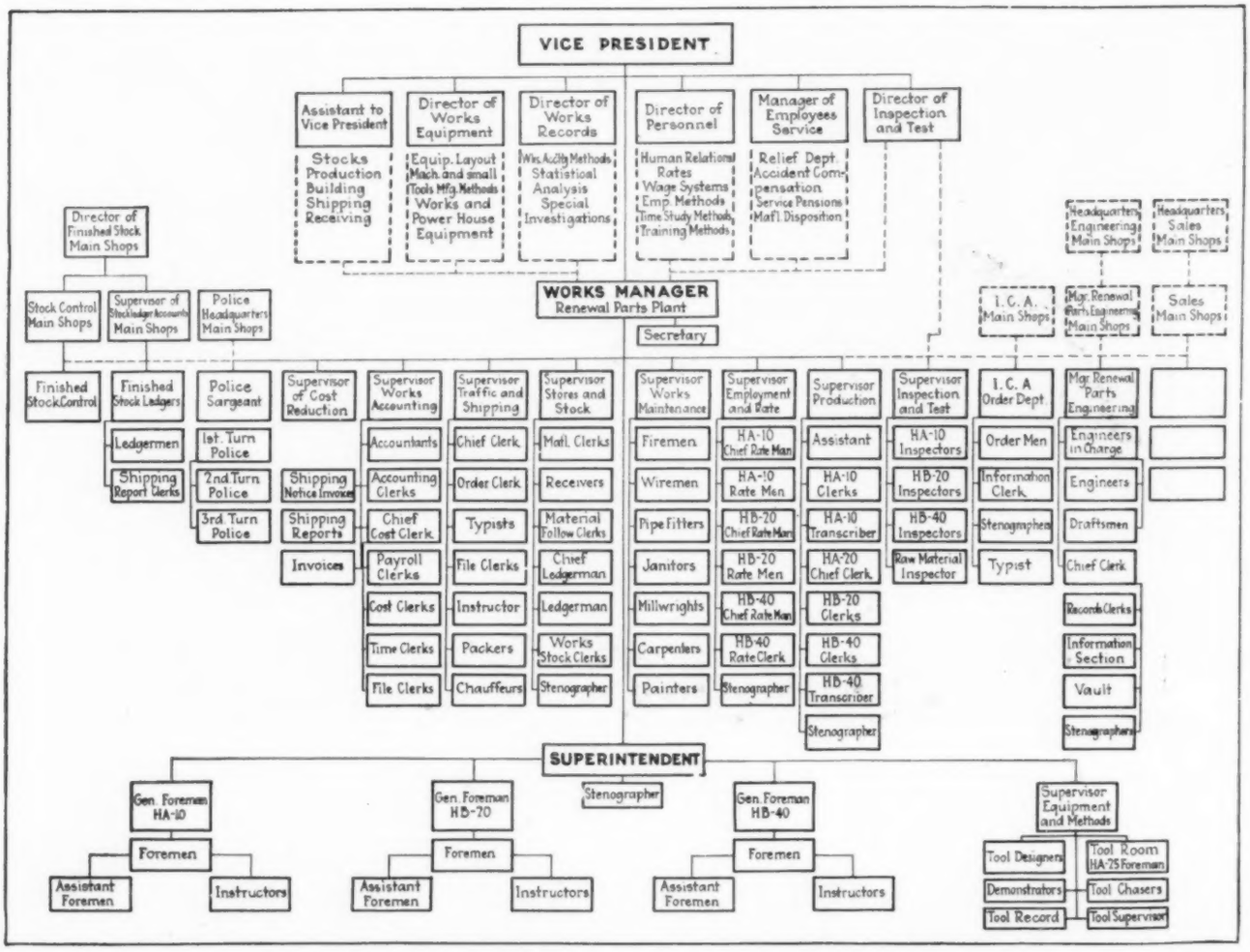
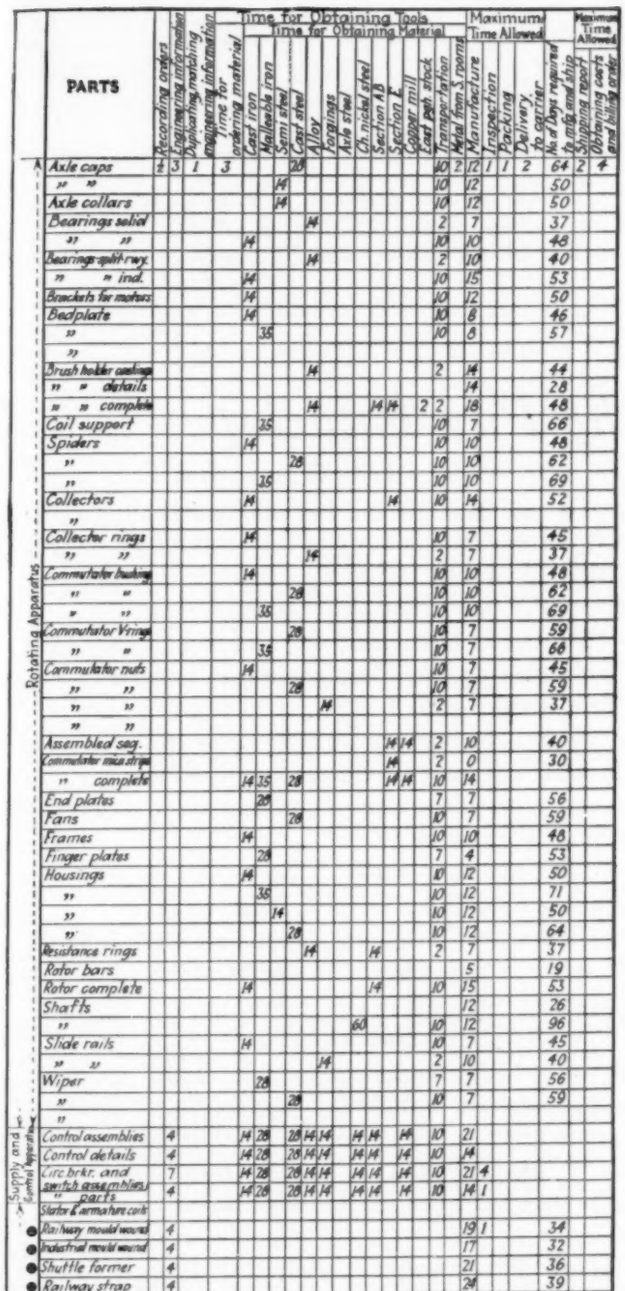


Fig. 2—Organization chart of a replacement parts plant

largely on the cost of manufacture of the part. If an order for one part only is received, the maximum charge is made. But this price decreases as the quantity order increases, and gives an opportunity for greater distribution of set-up and overhead cost. On practically all orders for single parts for old machines, the jobs are done at a loss, and the loss must be charged up to service and customers' good will. A cumulative record is kept of all orders for parts, however, and where it is found that the frequency of calls for a particular part warrants it, a quantity of the part is made up for stock. The number of orders received averages 100 per day. These are assigned to clerks working on a task basis, who prepare the preliminary data and schedule the work. Most of the parts ordered fall into certain general classes, and schedule tables, such as shown in Fig. 3, are used for estimating the time in the various phases of manufacture. In most cases, a maximum of 7½ days is allowed for preparing and routing the shop order, preparing the engineering specifications, and ordering raw material. The time for obtaining

Fig. 4—One corner of the storeroom of the Homewood plant. All parts are boxed before storage, in order to save space, and to keep them clean



	PARTS	Recording orders	Engineering information	Duplicating, matching	Engineering information	Time for ordering material	Time for Obtaining Material: Cast iron	Malleable iron	Semi steel	Cast steel	Alloy	Forgings	Arb steel	Ch. nickel steel	Section AB	Section E	Copper mill	East path stock	Transportation	Metal from S. perms	Maximum Time Allowed: Manufacture	Inspection	Packing	Delivery to carrier	No. of Days required to mfg. and ship	Shipping report	Obtaining cards and billing order	Maximum Time Allowed
Rotating Apparatus	Axle caps	±	3	1	3					28									10	2	12	1	1	2	64	2	4	
	" "							14											10		12				50			
	Axle collars							14											10		12				50			
	Bearings solid									14									2		7				37			
	" "						14												10		10				48			
	Bearings split-rwy.									14									2		10				40			
	" " ind.						14												10		15				53			
	Brackets for motors						14												10		12				50			
	Bedplate						14												10		8				46			
	"							35											10		8				57			
	"																											
	Brush holder castings										14								2		14				44			
	" " details																				14				28			
	" " complete										14				14		2	2			16				48			
	Coil support							35											10		7				66			
	Spiders						14												10		10				48			
	"								28										10		10				62			
	"							35											10		10				69			
	Collectors						14									14			10		14				52			
	"																											
	Collector rings						14												10		7				45			
	" "									14									2		7				37			
	Commutator bushing						14												10		10				48			
	" "								28										10		10				62			
	" "							35											10		10				69			
	Commutator V rings								28										10		7				59			
	" "							35											10		7				66			
	Commutator nuts						14												10		7				45			
	" "								28										10		7				59			
	" "										14								2		7				37			
	" "																											
	Assembled seg.															14	14		2		10				40			
	Commutator mica strips															14			2		0				30			
	" complete						14	35		28						14	14		10		14								
	End plates							28											7		7				56			
	Fans								28										10		7				59			
	Frames						14												10		10				48			
	Finger plates							28											7		4				53			
	Housings						14												10		12				50			
	"							35											10		12				71			
	"								14										10		12				50			
	"								28										10		12				64			
	Resistance rings									14				14					2		7				37			
	Rotor bars																				5				19			
	Rotor complete						14							14					10		15				53			
	Shafts																				12				26			
	"												60						10		12				96			
	Slide rails						14												10		7				45			
	" "									14									2		10				40			
	Wiper						28												7		7				56			
	"								28										10		7				59			
	"																											
Supply and Control Apparatus	Control assemblies	4					14	28		28	14	14		14	14		14		10		21								
	Control details	4					14	28		28	14	14		14	14		14		10		14								
	Circ. brkr. and switch assemblies	7					14	28		28	14	14		14	14		14		10		21	4							
	" parts	4					14	28		28	14	14		14	14		14		10		14	1							
	Stator & armature coils																											
●	Railway mould wound	4																			19	1			34			
●	Industrial mould wound	4																			17				32			
●	Shuttle former	4																			21				36			
●	Railway strap	4																			24				39			
●	Industrial strap	4																			21				36			
* ●	Field coils	4																			18				33			
* ●	Blowout coils	7																			14				32			
	Brakes	7					14	28		28	14	14		14	14				10		21								
	Armatures	7					14	28		28	14	14		14	14		14		10		21								
	Gear cases	3						35											10		14				73			
	" "																											
	Power coils	5																										
	Rewinding material																											
	Railway & Industrial	3																			8				20			
	Power & large industrial	5																			6				20			

* Add 20 days when alloy terminals or shells are required

● Add 60 days when non-stock wire is required
Add 60 days when non-stock strap is required

Fig. 3—Sample schedule sheet for estimating dates of finishing and delivering replacement parts

the raw material will naturally vary widely, since it must be obtained through the main plant stores. Or in the case of an old-stock part that requires material not now current, it may have to be ordered from the mill. In all cases, however, exact schedule dates are given on the shop orders, and each department head is responsible for meeting that part of the schedule. A superintendents' conference is held once a week to determine causes of delays, and to give any department head a chance to place the blame for delay where it may belong. In this way, a definite date for shipment of the part can be given to the customer.

The "office overhead" of a replacement parts plant will naturally be below that required for a production shop, since sales and advertising are non-existent, and since most of the engineering and design has already been done when the part was a production product of the main plant. But at the Homewood plant, additional efforts have been made to keep down this ratio of overhead. One production man and one chief inspector are considered as office men, and their assistants are in the shop at all times. Time study and bonus methods are operated throughout the plant, and the time-study men prepare job cards for each job passing through the shop. These studies form the basis of the master schedule sheets, as well as serving for operation data sheets, and for rate setting. More than 800,000 separate operations have been written up and filed in this way.

The employment and rate departments are unified under one control, because of the interlapping of their operations in the shop. By this means, it is considered possible to give more efficient attention to rates of pay as applied to the individual.

File Maintained for Only Six Months

There are no commodious files and archives at the Homewood plant office. All orders and correspondence pertaining to them are kept in a central order file for a period of six months after completion of the orders, or, in the case of large or unusual orders, for one year. If nothing comes up in regard to an order in that time, it is thrown out of the files. The space saved, and the convenience, are considered more than sufficient to pay for any occasional expense in re-estimating a follow-up order. Questions on part orders that have been delivered six months are not likely to arise.

Space is likewise conserved in the storeroom by boxing the parts before storage. This procedure is especially followed with castings, axles, and other parts that are irregular in shape, and where the boxes or crates can be piled up readily. It also keeps the parts clean, and eliminates the need for polishing or refinishing before shipment where renewal parts are stored for long periods. In many cases, it has been found that the space saved, figured on a square-foot overhead charge, pays for the entire cost of boxing.

Incentive plans are applied to all working conditions of the plant. The production department prepares charts of the status of all orders in the shop, and posts these in the shop where they can be studied by both foremen and workmen. In addition to this, the works manager is furnished a weekly report of department efficiency, which is based on production, overdue orders, scrap, and other pertinent items. Each department is then rated according to this report. Before coming to the weekly superintendents' meeting, each general foreman makes out a written report of conditions of overdue orders, excessive scrap, or other factors affecting production. The chief value of this report is that it makes him analyze the situation in his department. Scrap is collected at intervals, and is tagged to show how much money was lost to the company by the error. Under the working of this general plan, the average of all departments has been kept up to an efficiency of 98 per cent, and the scrap has been kept down to one-tenth of one per cent for a year.

· THE · FOREMAN'S · ROUND · TABLE ·

The following narrative is a "case" presentation of the topic. It has been written to involve some of the questions that arise in the average shop. For guidance in preparing discussion the questions at the foot of the page have been prepared

Something Besides the Pay Envelope

"GUESS Williams has been falling for some of your 'human interest' stuff, Al. Here's some sort of a dope sheet he calls 'Shop News.' Wonder how often he's going to spring this on us to read?"

"Williams has had that in mind a long time, Ed. We've talked it over a number of times. Lots of plants find it helps stir up interest and keeps men interested—and that's a big problem in any shop."

"Why bother about that, Al? What do you care whether every man in your gang is interested or not? All you want is big production and low cost. What if he doesn't care what happens so long as he turns out the work?"

"There are several reasons, Ed. First of all a man who isn't interested can very seldom do as good a job as the one who is. He's more apt to make mistakes and ball things up by not showing up when you need him the most."

"You can always fire him, Al."

"Gosh, Ed, you certainly are hard-boiled this morning. Sounds like indigestion, or poor coffee for breakfast. You know darn well that the next uninterested man is just as apt to spoil things as the one you fire. If Williams thinks it's worth while to try and interest them, it's up to us to help him."

"Boosting the pay envelope wouldn't do any harm, Al. They'd all be interested in that. And I'm inclined to believe that it's about the only thing they do care about."

"If that's true, Ed, we're in a bad way. We're paying the going wage rate now, or a little better—and I agree that you can't do much to keep men happy unless you are. But there's a limit to raising wages above the going rate. So we've got to find some other way."

"But do you really believe, Al, that it makes any difference in the long run?"

"I do, Ed. Not only in spoiled work but in general reliability. It affects the care of machines and the waste of material. If a man doesn't get some 'kick' out of his job he's missing a lot—and so is the job. If he can't get interested in the work, he had better find some other kind of a job."

"I suppose you think the men care a whoop where the machines go after they're built, and want to show 'em pictures and a lot of other things. Well, I don't believe they care at all."

"You're all wet, Ed. I'm sure they would be interested in a lot of things about the business, and will find some things in Williams' little 'Shop News.' If you don't, you'd better see a doctor—there's something wrong with you somewhere."

Is Ed right in thinking that the pay envelope is the only interest in the job? Or is Al right in believing that you get better work and more reliability by telling the men about the plant? What are the points of greatest interest to the men?

All foremen are urged to discuss these questions vital to their work; of course the

discussion is not limited to foremen. Letters accepted and published will be paid for

Discussion of Earlier Topics

Extra Pay for Extra Effort

I BELIEVE that Al was right in saying that the piece rate should not be cut, and that no bonus should be given when the operator is able by the use of extra effort to bring the production from 50 pieces up to 70. If he should discover, however, a new method for doing the work which increases the production, a bonus should be paid to him. Then the rate should be cut, being sure to set the new one so that he could earn at least as much as formerly with the same amount of effort. If the rate were cut without a bonus being given, the tendency would be to discourage any further improvements or suggestions from the operators to speed up production.

—F. E. CLARKE.

He Never Asks for a Raise

IF ED had cultivated the friendly regard of Bill Hankins, which he could have done without losing Bill's respect for him as his superior, it would be hard to imagine Bill leaving without first giving his friend Ed a chance to retain his services. This is where a foreman's personality comes in. On the other hand, if Ed had ascertained Bill's state of mind from time to time he would have known when to give him a raise. Bill's case is typical of that of other workmen who have been kept dragging along at a wage less than they are worth.

—EDGELL R. PLAISTED.

BOTH Bill Hankins and the foreman are both at fault in adjusting the matter of a raise. I do not see why Bill could not have asked if there was a chance for more money before he made his final decision to leave the company. Yet, on the other hand it is a very important part of the foreman's duty to see that the men are not underpaid, so that the company's reputation is thereby kept at a high standard for fair dealing. Usually, I try to give a man a raise before he asks for it. However, I find that those who do ask for it are over-estimating themselves.

—R. Q. TARBUTTON.

ANY man with sufficient intelligence to make a good employee knows when he is rendering full value for what he is paid. He knows also that with length of service and increased skill he is able to earn more per hour for his employer, and the latter also knows this. If this increase in the value of his services is not acknowledged he can only assume that no thought is given to his welfare. He will naturally be discontented, and the difference between a contented and a discontented person in appearance, speech and general attitude is so marked that any foreman could readily tell how he felt.

A periodical and systematic program of raising should be in effect, so worked out that individual skill and merit are rewarded in proportion to the value of such services to the company.

—D. L. PARKHURST, *Chief Instr. Div., U. S. Coast Survey.*

THE · NEXT · TOPIC

Putting Color on the Machinery

ADVANCE QUESTION

Al runs into a shop that has its machines painted in four colors, and likes the idea of getting away from black and gloomy surroundings. Ed thinks it is just "jazzy." What do you think?

Shall It Be Layoffs or Short Time?

PERHAPS the following method in use in our shop of handling layoffs or short time will be of value to others. At all times, we carry on with a medium force that has been maintained intact. During busy periods each man has several jobs ahead, which induces him to work at his best speed. On the other hand, when a slack time comes we design and build such new jigs and tools as are needed. Furthermore, we have reached out to manufacture parts previously bought outside, a policy which brings to us another source of work during poor business periods.

—P. W. NIELSON, *England.*

WHEN a slack period approaches, I lay off the men who are below the average in ability, and have the rest work short time. The staff is kept together better by steady work at short hours than by full time for every other week. Such a system keeps the men in a better frame of mind since they cannot look forward to a period of enforced idleness.

—C. L. HENRY, *England.*

Paying a Bonus to Outsiders

THERE are occasions when through general familiarity with the work the outsider can make suggestions that result in increased production. It is hard to say just why, in all fairness, there should be any question as to this man participating in the resultant profit. The profit is there whether he was working on the job or not, and it was his thought that made this profit possible.

—R. B. SMITH.

· TECHNICAL · ABSTRACTS ·

Production of Platinum Vacuum Tube Filaments

The filaments of vacuum tubes used by the Bell System consist of ribbons of carefully-prepared platinum alloy coated with the oxides of barium and strontium to give a higher electronic emission. There is usually no reaction between the platinum and the barium and strontium, but if such reactions should take place the thermionic activity of the coating is not impaired. If any compounds are formed with the platinum, they are dissipated by the heat generated in the process of evacuating the tube.

Since platinum is not commercially produced in a form pure enough for filament cores, it is necessary to refine the metal to a purity of at least 99.98 per cent. The purity of the metal is readily determined by a thermoelectric test, the thermal e.m.f. developed between the sample being tested and one of known purity giving a direct measure of the impurities present. It is interesting to note that the spectroscope is used as a rough check during the purification processes.

After the purified platinum and alloy sponge is produced, it is pressed into pellets and melted in an induction furnace at a temperature of 3,400 deg. F. The metal is next rolled and swaged into a rod $\frac{1}{4}$ in. in diameter and 3 ft. long. An oxyhydrogen torch is used at this stage to work out gas pockets and bubbles in the metal which would interfere with subsequent drawing operations. The rod is then drawn into wire to produce flat rolled strips varying from 1 to 13 thousandths of an inch in thickness.

The ribbon thicknesses are so small that micrometers cannot be used for checking purposes. For use in ordinary filaments, the cross-section of the wire is determined by weighing a sample one meter long. However, where the greatest accuracy is required, the width of the ribbon is determined by projecting an image magnified 1,000 times upon a screen properly calibrated.—*Bell Laboratories Record*, April.

Heat-Treatment of Aluminum and Its Light Alloys

Heating castings at about 400 deg. C. (932 deg. F.), for two or three hours will relieve internal casting strains. It is a known fact that the aging affect which many cast aluminum alloys exhibit on standing may be accelerated by heating from three to four hours at 165 deg. C. (329 deg. F), with simultaneous improvement in properties. Long-time heating up to 96 hours in some cases, has the effect of spheroidizing certain constituents, thus breaking up an embrittling network of hard components, and consequently increasing the ductility and resistance to impact stresses.

Permanent growth of aluminum castings may be conferred by heating to about 425 deg. C. (797 deg. F.) followed by slow cooling. When a casting so heated is cooled to the ordinary temperature, it will be measurably larger in size than before the heating. With a casting 4 in. in diameter, the growth may amount to 0.004 in. However, at the same time internal strains are removed by the process.—Robert J. Anderson, *Fuels and Furnaces*, April.

Education of Workers Aids Progress

In tracing the causes of social unrest among employees, the subject of inadequate education of workers is a consideration of importance. Of the millions of children entering the public schools, only a small percentage continue through to high school. Therefore, only a small percentage of our workers have received the foundation of mental training which equips them properly to succeed in their work or to fully comprehend the meaning of business in its present-day complex form.

The worker should be informed of the part played by banks and other financial institutions, public utilities, railroads, and large corporations. Generally speaking, the working man finds these "dry" subjects, and is more interested in his automobile, his garden, or his radio. If the worker is not given a true basic picture of the things which go to make up the modern business edifice, some disturber comes along with fantastic tales of exploitation and implants dangerous seeds of unrest and bitterness in his mind. In past years, twelve to fourteen hours of daily labor, small wages, and other considerations made the workman a "put" factor in our community life. Today, all this is changed, and with moderately priced cars and attractive suburban homes within reach of his income, a new field of broader living has stimulated ambition and desire, and mass education has become a path to the goal of contentment.

The General Electric Company, through the industrial service department of its various companies, offers student engineering courses in electrical and mechanical engineering. It also offers its workers educational opportunities in the form of organized apprentice courses. The Westinghouse Electric & Mfg. Company offers a comprehensive educational program to its employees by training men to be supervisors, and enabling those who are supervisors to become still more proficient. It also runs a technical night school for men and women who wish to "learn while they earn." Education of employees in the principles of modern business finance and stock ownership, and intensive training of the individual to make him a better worker, are also proving in many places to be effective mediums for competing and neutralizing tendencies which threaten unhappy rifts between employer and employee.—William W. Ayre, *Industrial Digest*, April.

Small Shop Benefits by Material Handling Methods

The development of a new product brings methods of materials handling to the fore as an important feature of reducing costs. A typical example where such methods were consciously studied and applied is that of a concern which has built up a successful business of manufacturing gas stoves. Because of the many mass production operations required, it was found necessary to develop methods of handling which would carry over through several operations, and prevent damage. An orderly, logical fabrication of gas stoves without confusion or waste has resulted.

Careful attention is given to economy and facility of operation of the handling equipment from the unloading of pig iron to the final crating. Contrary to the usual sloppy practice, pig iron is neatly stored in piles separated by concrete runways. Four-wheel box trucks hauled by an electric lift truck transport the iron through the foundry operations and finally deliver the castings at the enameling department.

Castings to be enameled are mounted on small metal racks. Following the spraying and air drying operations, the racks are placed on a carriage suspended from a structural frame directly in front of the firing furnace. The carriage is picked up by a charging buggy and delivered into the furnace; the charging buggy bed being lowered and withdrawn during firing.

To prevent damage to the enamel coat on castings or pressed parts at minor assemblies, it has been found necessary to use removable trays and cross pieces in conjunction with platform trucks. When loading the parts, a tray is placed on the platform and filled carefully.

Conveyors are used for transporting castings and pressed parts from the enameling department to the storeroom and also for the assembly line. In the former case, the canvas belt conveyor carries the parts spaced so that they do not touch. This particular conveyor has eliminated a second inspection for materials damaged in transit, and has reduced costs considerably.

The most vital part of the assembly department is the 130-ft. conveyor. The skeleton stove is assembled on the benches and removed to the traveling platform. Subsequent operations are performed with so much dispatch that 30 men turn out 225 stoves per day.—*The Iron Age*, April 5.

Applying Navy Methods in Wage Adjustment

By A. H. RODRICK
Industrial Engineer

WAGES, especially those of industrial workers, cannot remain stationary—they must be adjusted from time to time to meet changed conditions. In no branch of human endeavor do the principles of demand and supply and competition prevail with such importance as they do in the case of productive labor. Executives, and sometimes the lower paid office workers, are employed by contract which fixes their salaries for a definite period of time. Such a procedure is rarely ever followed in the case of shop employees; their employment is at times unstable, and they pursue their trade or occupation where wages and working conditions are most attractive. The Navy Department has a system of adjusting wages which has been in use at its industrial establishments for years, the principles of which are applicable to any type of private factory. The Act of Congress of July 16, 1862, provides: "That * * * the rate of wages of the employees in the navy yards shall conform, as nearly as is consistent with the public interest, with those of private establishments in the immediate vicinity of the respective yards, to be determined by the commandants of the navy yards, subject to the approval and revision of the Secretary of the Navy." In accordance with existing law the rates of wages of employees in the clerical, administrative, and fiscal service; drafting service; scientific, professional, and technical service; inspection service; supervisory mechanical service; planning and estimating service; laborer, helper, and mechanical service and others are determined annually by the commanding officers of the navy yards and naval stations, subject to the approval and revision of the Secretary of the Navy, and take effect the first of each calendar year.

Wages in navy yards are adjusted according to law by special boards appointed by commanding officers of each yard. The board members are expected to adjust navy yard wages to line up with wages in nearby private industries. Three rates are fixed, maximum, intermediate and minimum, that differ by five cents an hour. The procedure used could be adopted by private enterprises facing a similar situation

At each navy yard or naval station the commanding officer appoints a board on wages composed of three commissioned officers as members and a civilian employee as recorder, which convenes on the fifteenth of August of each year, or as soon thereafter as practicable. The members are officers attached to the three divisions of the yard or station employing the largest number of civil employees, and the entire board membership are relieved of as much of their other duties as may be practicable, in consideration of the importance of this work.

The board reports to the convening authority the result of its inquiries and other work and recommends a rate of wages for each trade and occupation based thereon. In the report is a tabulation of the current and recommended rates for each trade and occupation and an index of the names of private establishments from which wage data were obtained.

Before finally determining upon a list of private establishments within the sphere of inquiry from which data are to be obtained and considered, the board prepares a tentative list of what it considers to be "representative private establishments." It then invites committees, appointed by the employees of any trade or occupation who desire representation before the board to represent them, to submit a like list, and they are allowed three days for this purpose. The board then affords the committees full opportunity to present arguments for or against any of the firms under consideration. Upon conclusion of hearings the board prepares a final list of "representative private establishments." Committees may appeal in writing from the decision of the board relative to any particular one to the Secretary of the Navy, via official channels.

The board considers any evidence submitted by committees as to the rate of wages paid by private establishments in the vicinity of the navy yard or station. Committees are given a hearing before the board and are allowed to submit all data possible to substantiate their claims. The hearings are held at such times as will permit the board to make further inquiries of the establishments, if deemed desirable, to reconcile differences, if any, between the evidence presented and that already in possession of the board. Where differences are found to exist, the board brings them to the attention of the committee concerned, and where marked discrepancies are found in the data obtained by the board and that presented by committees, the board personally visits the private establishment in question for the purpose of reconciling such discrepancies.

Because all navy yards and naval stations operate on the basis of eight hours a day, forty-eight hours a week, the determination of the wage data by the board is as follows:

(a) The daily wages paid by a private establishment operating on a work week of six full working days of more than eight hours each, on either a daily or hourly wage basis, is considered the wages paid for a normal day's work in that establishment. The hourly rate of wages is ascertained by dividing the daily wages, adjusted to the nearest multiple of eight, by eight.

(b) The daily wages paid by a private establishment operating on a work week of less than six full working days, aggregating more than forty-eight hours, on either a daily or hourly wage basis, is ascertained by dividing the wages paid for a normal week's work in that establishment by six. The hourly rate of wages is ascertained by dividing the daily wage, adjusted to the nearest multiple of eight, by eight. Where a private establishment is operating on an eight-hour day and less than a six-full-working-day week, the daily or hourly rate of wages only is considered. The normal work period in any case does not include overtime, since overtime is time worked in excess of the normal work period, and usually an increased rate is paid therefor.

Weighted Average Pay

The board computes the weighted average pay per hour in the maximum rates of wages and the weighted average pay per hour for all rates of wages for each trade and occupation by multiplying the maximum rates per hour for each trade and occupation in each establishment by the number of men at these rates in the establishment. The total of all products thus obtained divided by the total number of men employed in the maximum rates will be the weighted average pay per hour in the maximum rates. The same procedure is followed in computing the intermediate and minimum rates. The total of all maximum, intermediate and minimum products divided by the total number of men employed at all rates is the weighted average pay per hour for the trade or occupation. Where establishments report more or less than three rates of wages the board uses its best judgment in allocating the rates of wages to maximum, intermediate and minimum rates.

The convening authority forwards to the Navy Department, within ten weeks, the report and recommendations of the board, with his comment and recommendations. A copy of the board's report and recommendations, together with the comment and recommendations of the convening authority, are posted on the bulletin boards of all activities affected for the information of all concerned.

A departmental wage board of review is then appointed by the Secretary of the Navy to consider the reports and recommendations submitted, together with such other evidence as it may obtain, and makes recommendation as to the proper rates of wages for each trade and occupation under the Naval Establishment. The schedule of wages, upon approval and promulgation by the Secretary of the Navy, remains in force during the ensuing calendar year.

Among the various wage plans in effect in industry today there are group bonus plans and individual bonus plans, group piece rate and individual piece rate, group premium and individual premium, and other methods of rewarding labor, but the Navy's industrial establishments use the hourly rate. The annual Naval appropriation act forbids the use of a stop watch or other time-measuring device while making or causing to be made a time study of any job of any employee between the starting and completion thereof, or of the movements of any employee while engaged upon such work. The same act, however, authorizes the payment of premiums, bonuses or cash rewards to employees in addition to their regular wages for suggestions resulting in improvements or economy in the operation of any Government plant.

In fixing the hourly rates a maximum is adopted, the intermediate rate is usually $0.05 per hour less than the maximum, and the minimum rate is usually $0.05 per hour less than the intermediate. By this method the efficient and deserving employee can be rewarded, and each employee knows the exact wage for which he is striving in increased effort. A requisite of any successful wage plan is that every employee shall be able to figure his own pay.

Employees who work in excess of eight hours on the same calendar day are paid the daily rate plus 50 per cent additional; those who work on Sundays, not exceeding eight hours, are paid the daily rate plus 50 per cent additional; those who work on legal holidays, not exceeding eight hours, are paid the daily rate plus 50 per cent additional, and, in addition thereto, are allowed gratuity pay for the legal holiday; those who work in excess of eight hours on Sundays or legal holidays are paid 50 per cent additional to the Sunday or holiday rate. Employees whose whole time of work or any part thereof is between the hours of 6 p.m. and 7 a.m. are paid $0.05 per hour in addition to their regular rate for work performed between the hours mentioned, except that no employee is allowed to receive extra pay for night work for which he is paid Sunday, holiday, or overtime rates.

At the Navy's industrial establishments employees who work regularly on Sunday are required to take an equal amount of time off during the week preceding or succeeding such Sunday, and employees are required to rotate on Sunday work as far as practicable.

No Need for Secrecy

It may be contended that in private establishments wages cannot be adjusted strictly in accordance with the above practice because competitors do not care to make known what they are paying their employees. It must be admitted that at one time this was true but with the introduction of scientific industrial management and personnel administration employers are coming to realize there is no longer any advantage to be gained in keeping such information confidential. Employees are not now hired indiscriminately in well regulated industries but are interviewed by a competent employment manager, and on practically every application for employment will be found the question: "Where did you last work and what wages did you receive?" In addition wage statistics are made public by the Census of Manufacturers, Bureau of Labor Statistics, and by the labor departments of states.

It is good management for any employer to standardize wages for it is a means of creating a permanent working force. The one way to do this is to adjust them to meet present conditions, for as Warren B. Catlin, in his book, "The Labor Problem," points out, "the objects of the average wage-earner's expenditure and the content of his standard of living change with time and place and with the progress of invention and the arts."

Shaper Tool Research

Effect of Front and Side Rake

By Donald L. Perkins
Assistant Professor of Shop Practice, University of Michigan

Tool efficiency depends upon nose shape and amount of front and side rake, but power consumption is affected only by the latter

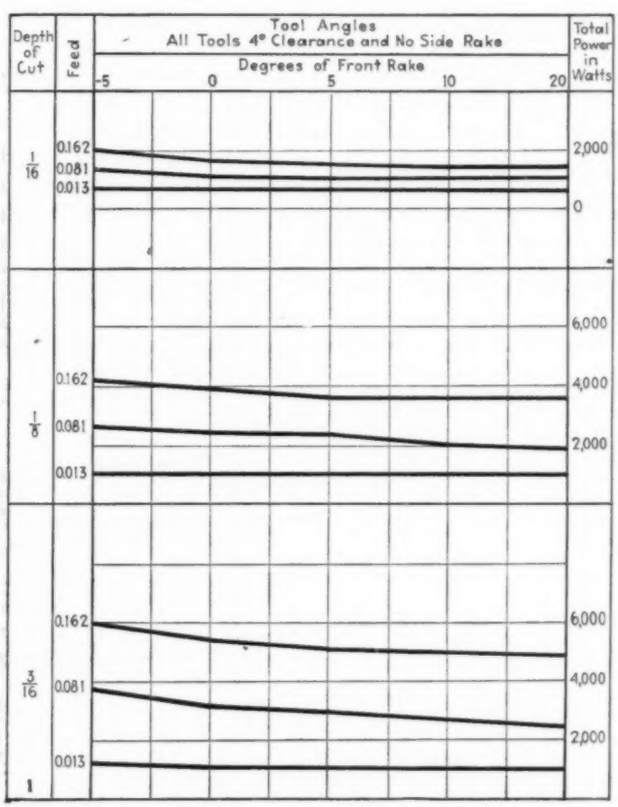
AN EFFORT was made during the writer's investigation of "The Art of Cutting Metals" on a shaper, to determine the tool form to give the greatest economy for a definite length of stroke and cutting speed. In this article, the results are given of experiments in which the front and side rakes were varied and the power consumption noted. Experiments were also conducted to determine the effect of a few definite combinations of front and side rake.

Previous to this shaper investigation, the writer was associated with an investigation of planer tools and personally made tests to determine the practical degree of tool sharpness and the effect of the clearance back of the cutting edge. These tests showed, in regard to tool sharpness, that there was no appreciable difference in power consumption until the tool became visibly dull or blunt. These tests also showed that there was no noticeable difference in the cutting action of the tool, nor in the surfaces of the material cut, until the tool was actually blunt. The tests relative to the influence of the clearance back of the cutting edge showed that the variation of the clearance angle had no influence on the power consumption, provided there was some positive clearance.

The writer believes that these tests warranted the use of right-hand roughing tools for the shaper experiments, all of which had 4-deg. clearance back of the cutting edge. The tools were repeatedly reground on a Gisholt tool grinder whenever there was any apparent dullness.

The angles selected for determining the effect of front rake were —5, 0, 5, 10, and 20 deg. These tools had no side rake whatever.

All material used was exactly 18 in. long. The shaper was operated at the lowest cutting speed of 9 strokes per min. This cutting speed made it possible to carefully note the feed dial readings, wattmeter movements, and cutting action. In using material 18 in. long and a



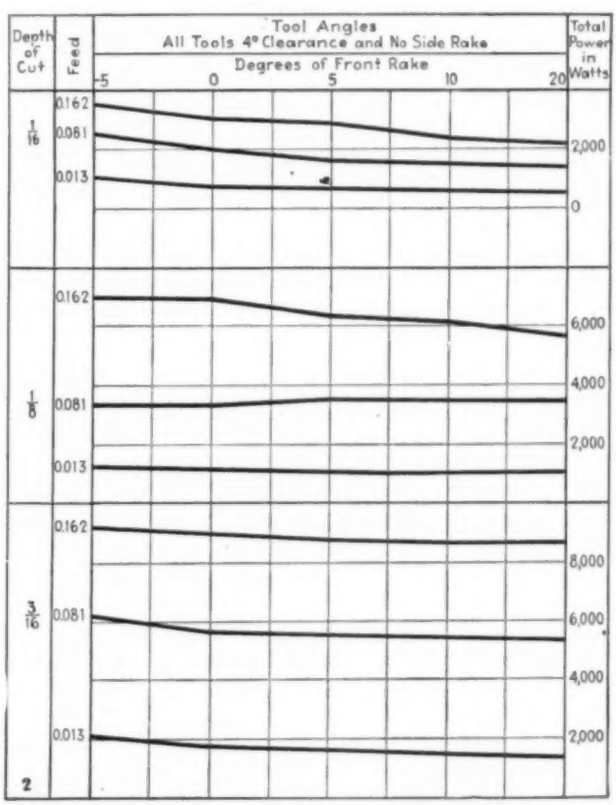
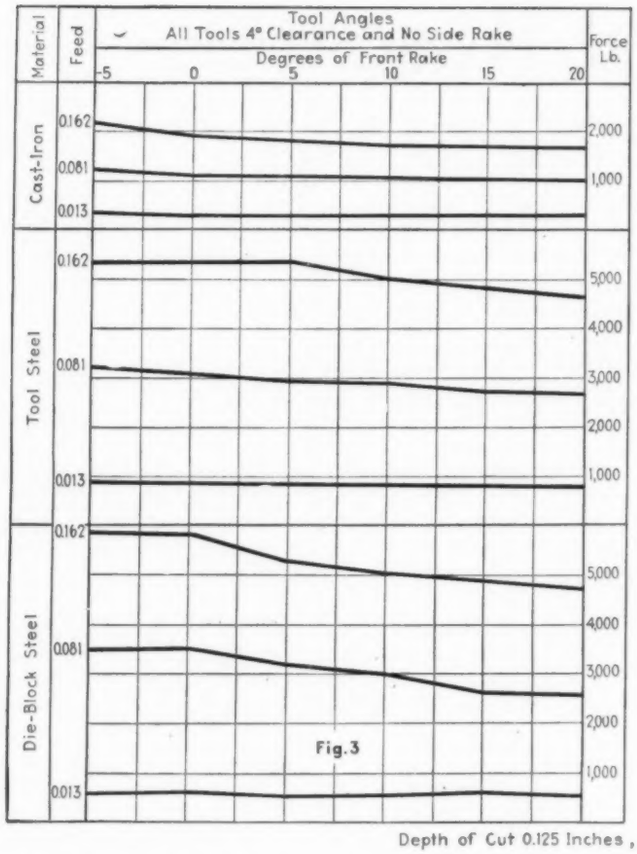
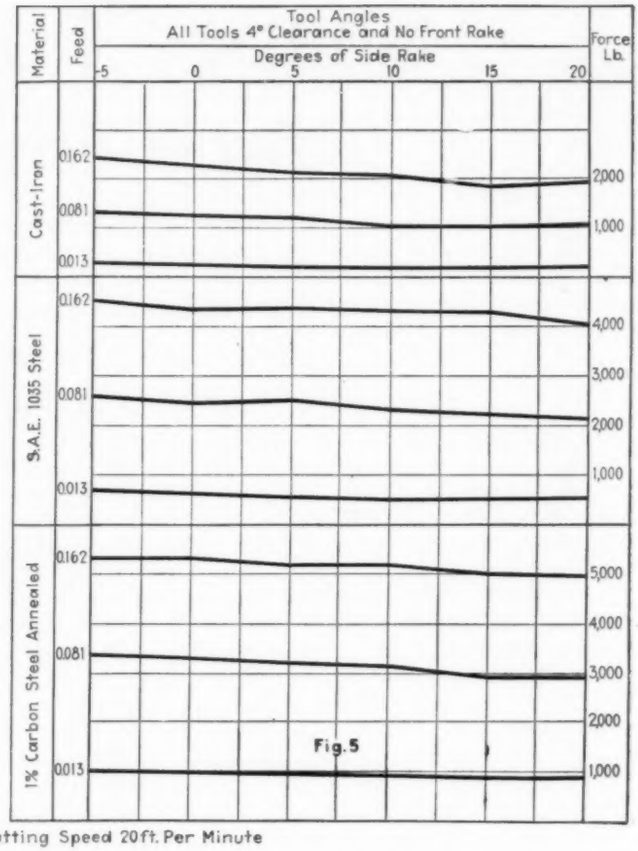


Fig. 1—Effect of change in front rake on power consumed when cutting cast iron. Fig. 2—Effect of front rake when cutting S.A.E. 1035 steel





Depth of Cut 0.125 Inches, Cutting Speed 20ft. Per Minute

Fig. 3—Results of check tests on a planer showing effect on power consumed of change in front rake when cutting cast iron, tool steel, and die-block steel. Fig. 5—Results of check tests run on a planer showing the effect of change in side rack when cutting cast iron, S.A.E. 1035 steel and 1 per cent carbon steel, annealed

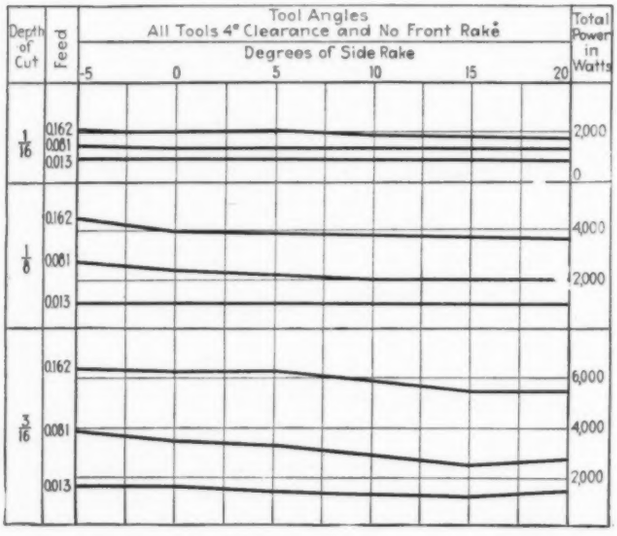


Fig. 4—Effect of change in side rake on power consumed when cutting cast iron in a shaper

cutting speed of approximately 27 ft. per min., it was found impossible to run the tool to a point of breakdown or definite wear, as the amount of material necessary would be enormous.

In Fig. 1 are shown the results of the experiments relative to the effect of front rake when cutting cast iron. There is a definite decrease in power consumption for increases in front rake. The decrease is more noticeable from negative to zero front rake and less in the range from 15 to 20 deg. Moreover, the larger the depth of cut and feed, the greater the effect of the increase in front rake. Chatter was very noticeable with —5- and 0-deg. front rake.

In Fig. 2 are shown the results when cutting S.A.E. 1035 steel. As the cutting action varied considerably, it was very difficult to obtain a series of consistent readings. For 0.0625-in. depth of cut, the increase in front rake caused a very definite decrease in the total power consumed for all feeds. The decrease in power consumed is greater between —5- and 0-deg. front rake. For the greater depths of cuts the same rate of decrease prevails on the average as can be seen from the chart.

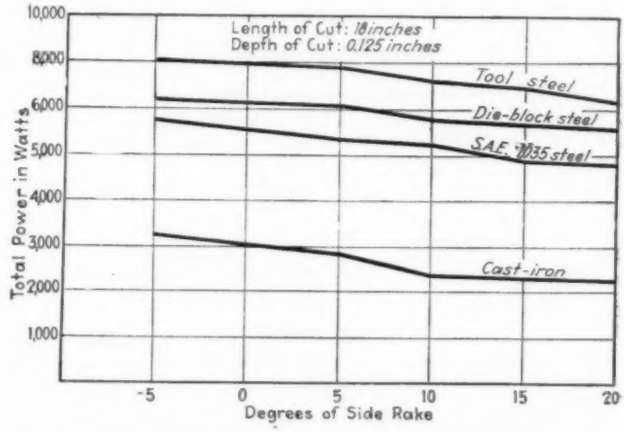


Fig. 6—Effect of change in side rake when cutting tool steel, die-block steel, S.A.E. 1035 steel, and cast iron

Tests on the planer where the dynamometer gives the total force at the nose of the tool, showed slight but definite and quite uniform decreases in the total force required for increases in front rake.

With die-block steel and tool steel, the amount of front rake had very little effect on the cutting action. There was, however, a slight decrease in power consumption for increase in front rake. In general the effect was least between —5 and 0 degrees.

In Fig. 3, the check tests made on a planer are shown. Although there was a definite decrease in the total force in pounds required at the nose of the tool for increase in front rake, it was so small that, in comparison with the total power consumption, it was difficult to show by the use of the recording wattmeter on the shaper.

The results in the front rake experiments were obtained for tools with no side rake. Here again difficulty was experienced in obtaining consistent readings. The author believed that this was due to the fact that the tools had no side rake. Therefore, experiments were later conducted in which tools with 10-, 20-, and 30-deg. side rake were used. The results of these later experiments showed very definite decrease in power consumption for increase in front rake.

The angles selected for determining the effect of side rake were —5, 0, 5, 10 and 20 deg. These tools had 0-deg. front rake. Other conditions for the experiments were identical with those maintained when determining the effect of front rake.

In Fig. 4 are shown the results obtained for the tools with varying degrees of side rake, but with no front rake when cutting cast iron. Similar results were obtained when cutting S.A.E. 1035 steel, tool steel, and die-block steel. In all cases there were very definite decreases in power consumption for increases in side rake. As in the experiments with tools of varying degrees of front rake, it was difficult to obtain smooth consistent

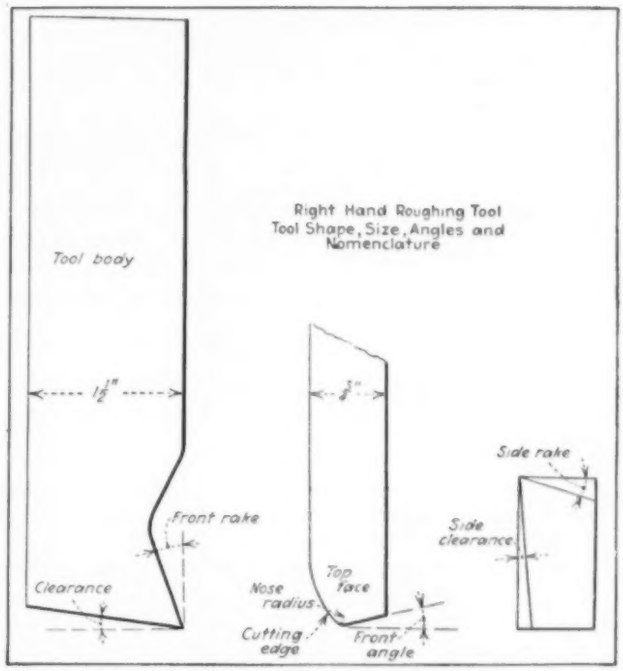
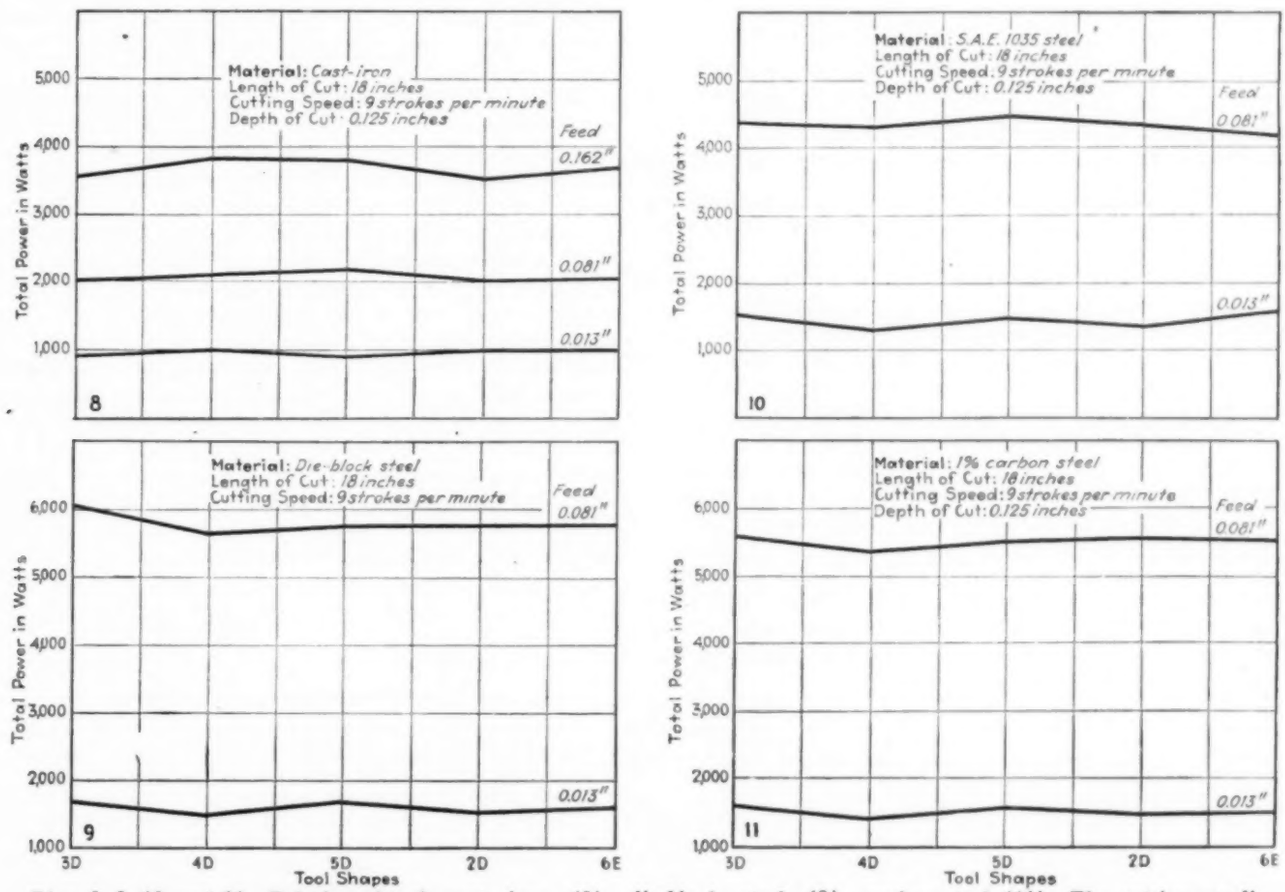


Fig. 7—Nose shape of shaper tool, general case



Figs. 8, 9, 10, and 11—Relation of tool shape to power consumed when cutting cast iron (8), die-block steel (9), S.A.E. 1035 steel (10), and 1 per cent carbon steel (11). The cutting conditions are the same in all cases

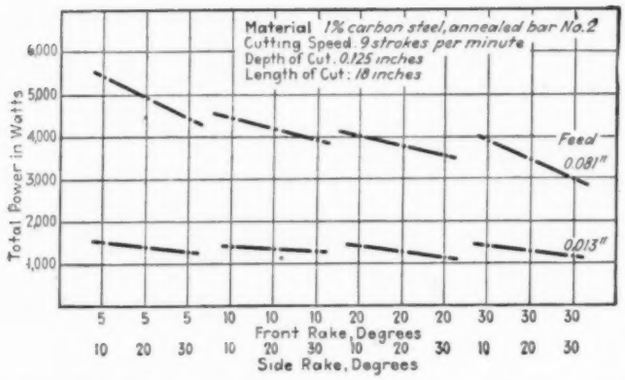


Fig. 12—Relation of power consumed to various selected combinations of front and side rake when cutting 1 per cent carbon steel

curves, probably because the tools had 0-deg. front rake.

In Fig. 5 are shown the results of check runs made on the dynamometer-equipped planer. The same tools and identical bars of material were used during these check runs. The results of check runs on the shaper, using bars of the four materials and for a depth of cut of $\frac{1}{8}$ in. and feed of 0.081 in. are graphed in Fig. 6. The transformer ratio was changed so that the total chart reading was 10 kw. This change was made to enable the operator to get a better chart of the cutting action. As a further aid, the speed of the chart was increased to 6 in. per minute. It can readily be seen that there were definite decreases in power consumption for increases in the amount of side rake.

The data collected from these experiments justify the conclusion that increase in either the front or side rake caused a reduction of power consumption in direct proportion. Experiments were next conducted to determine the effect of a few definite combinations of front and side rake, which were suggested by Mr. F. L. Eberhardt.

Definite Combinations of Front and Side Rake

Three tools were suggested with a nose shape as shown in Fig. 7. These tools are referred to as tools 3D, 4D, and 5D.

Tool 3D was suggested for use in cutting cast iron, and had 5-deg. front rake and 10-deg. side rake.

Tool 4D was suggested for use in cutting soft steel and had 0-deg. front rake and 20-deg. side rake.

Tool 5D was suggested for use in cutting hard steel and had —5-deg. front rake and 15-deg. side rake.

In addition to these three tools of definite combinations of front and side rake, two tools were selected to show the effect of the nose shape. Preliminary work showed that small changes in the curvature of the cutting edge did not cause any visible difference in the wattmeter readings or in the planer dynamometer readings. Therefore, two extreme nose shapes, 2D and 6D, were selected for showing the effect of nose shape. The results are shown together with those of the three suggested tool forms.

Tool 2D was ground with a square-end nose $\frac{1}{4}$-in. wide.

Tool 6D was ground with a side cutting edge at an angle of 45 deg.

Both tools 2D and 6D had 5-deg. front rake and 5-deg. side rake to avoid the difficulties encountered with tools having 0-deg. side or front rake.

In Fig. 8 are shown the results obtained with the five different tools when cutting cast iron. Tool 3D with 5-deg. front rake and 10-deg. side rake, which was the one suggested for cutting cast iron, required the least power.

In Fig. 9 are shown the results obtained when cutting die-block steel; Fig. 10 when cutting S.A.E. 1035 steel; Fig. 11 when cutting 1 per cent carbon tool steel. The results obtained showed very slight but definite differences in the power consumption of the three suggested tools.

Tool 4D, with 0-deg. front rake and 20-deg. side rake, which was suggested for soft steel, required the least power for cutting all the materials except cast iron.

Tool 5D with —5-deg. front rake and 15 deg. side rake, which was suggested for cutting hard steel, compared favorably only on die-block steel when taking cuts of wide feed.

The three tools recommended all had side rake, namely 10, 15, and 20 deg. The desirability of some side rake is fully recognized. The greater the side rake, the less the power consumption. In addition, the greater the side rake, the easier the tool feeds, but the greater is the tendency to dig in. Perhaps of more importance is the fact that the number of grinds possible per tool is less with increases of the side-rake angle.

Only One Roughing Tool Needed

The variation in front rake of the three suggested tools was —5, 0, and 5 deg. The —5-deg. front rake has a tendency to prevent digging in of the tool. It causes, however, a very noticeable chatter. So in the one case, the negative rake is favorable to a good finish, but in the other it is unfavorable because of the chatter. Since these tools are to be considered primarily as roughing tools, we are not interested in the finish. The results obtained clearly demonstrate that as far as power consumption is concerned, three different roughing tools are not necessary for the materials cut.

The extreme changes in the nose shape did not cause any apparent change in the power consumption. The average variation in the total force at the nose of the tool is only about 25 to 50 lb. with a maximum of 100 lb. It has been shown in a previous article how the chip cross-section varies for different nose radii and that the surface finish depends, therefore, on the nose shape. We are interested then in the nose shape only as it affects the surface finish, ease of tool grinding or tool life, but not as regards power consumption.

In Fig. 12 are shown some interesting results obtained when a further study was made of various combinations of front and side rake. The material cut was 1 per cent carbon tool steel. The length of cut was 18 in. and the cutting speed 9 strokes per min. An increase of either side or front rake, for a definite front or side rake, caused a decrease in power consumption. Throughout the various experiments it was always found that increasing side rake or front rake, or both, decreased the power consumption.

A Comparison of Methods

Next week those interested in sheet metal and press work, and in automobile construction, will have an unusual opportunity to compare American and European practice. One article deals with the manufacture of the frame for the new Ford, another with the method of combining body and frame into a single unit at the Lancia plant in Italy. The Lancia costs 20 times as much as the Ford, so the contrast should be worth studying.

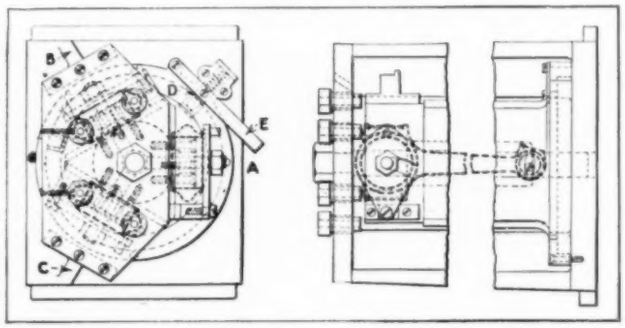
IDEAS · FROM · PRACTICAL · MEN

The department, "Ideas from Practical Men," is devoted to the exchange of information on methods useful to the machinery industries. Its scope includes all divisions of the metal-working industry, from drafting room to shipping platform. Descriptions of methods or devices that have proved their value are carefully considered, and those published are paid for. The rates are from a minimum of five dollars upwards, depending upon their merit

Fixture for Drilling and Reaming Bolt Holes in Connecting Rods

By Edward T. Heard

A fixture for drilling and reaming the bolt holes in the large ends of connecting rods in a multi-spindle drill is shown in the illustration. The work, indicated by heavy dotted lines, is loaded and unloaded at *A*, drilled at *B* and reamed at *C*. After the first rod has been



Indexing fixture for drilling and reaming connecting rods

drilled and reamed, the work on one rod is completed at each cycle of movement of the drill-head, making the operation practically continuous.

The work-carrying part of the fixture revolves on a central stud in the base and the rods are located on studs at both ends, being held in position by swinging clamps at the large ends. Indexing from one station to another is controlled by the spring index-pin *D*, operated by the lever *E*. The necessary bushings are carried in a stationary plate at the top of the fixture. The work is done before the caps are severed from the rods.

Press Tools for Piercing and Notching

By Henry Marsh

A great many mechanics when considering punch and die constructions think of them in the light of tools for blanking out simple parts or, as tools to bend articles to shape, with very little attention being given to refinements of design that will enhance the usefulness of the same.

Primarily the purpose of the pillar press tools shown in Figs. 1 and 2, is to pierce the holes *A* and *B* and to form the tongues and depressions at *C* and *D* of the bar shown in Fig. 3. Punches *A B C* and *D*, Fig. 1, are mounted in a block *E* that fits a groove in the punch holder. The punch *A* is round and is ground at its lower end with shear angles. Punch *D* shears out and forms

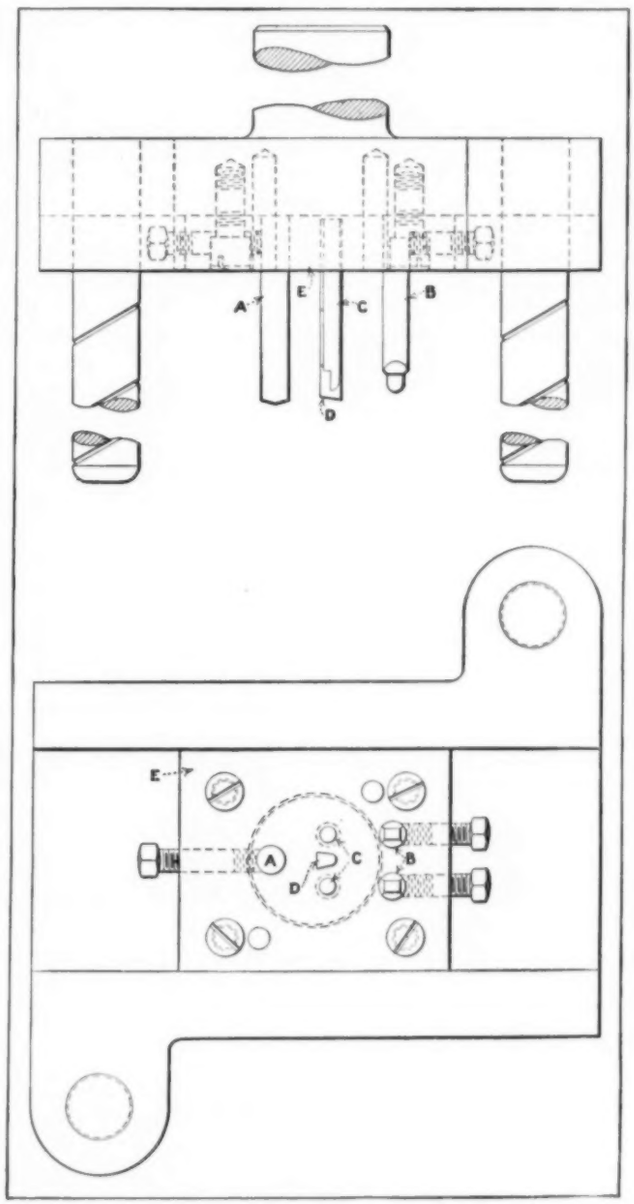


Fig. 1—The group of punches

the tongues *E* in Fig. 3, a suitable depression for them being made in the die. The two punches *C* make the slight indentations above and below the tongues, while the two punches at *B*, shear and form the depressions at *H* in the work.

Referring to Fig. 2, the die holder *A* is grooved so that it holds the die block *B* securely in place. On top of the die block is the overhanging stripper plate *D*,

placed so that the work can be slid under it readily. On top of the stripper plate are mounted two scales *E* and *H*. By means of scale *E*, in conjunction with the locating stop *J* against which the end of the work comes, the center of the hole *K* is located accurately from the end of the work. It will be observed that the end of the stop *J* comes in line with the end of the scale indicator and that finger *L*, attached to block *M*, is extended so that the scale reading will give the distance from the center to the end of the work. Block *M* is adjustable on the bar and can be securely clamped at any position by a screw.

An extension on the end of stop *J*, indicated at *N*, forms a handle by means of which the stop can be swung about pin *O* as a center so that it will be clear of the end of the work, thereby allowing the work to be slid along under it until the end comes against the stop *P* which is the correct position for piercing and notching the second group of holes *D* in Fig. 3, it being evident that stop *J* gives the location *W* in Fig. 3 while stop *P* Fig. 2 gives the location *X* in Fig. 3. Step *S* on stop *P* can be ground accurately so that it will register with the indicator *T*, which reads from the scale.

By loosening the three screws that clamp the die block *B* in place, the block can be slid out of its groove in the

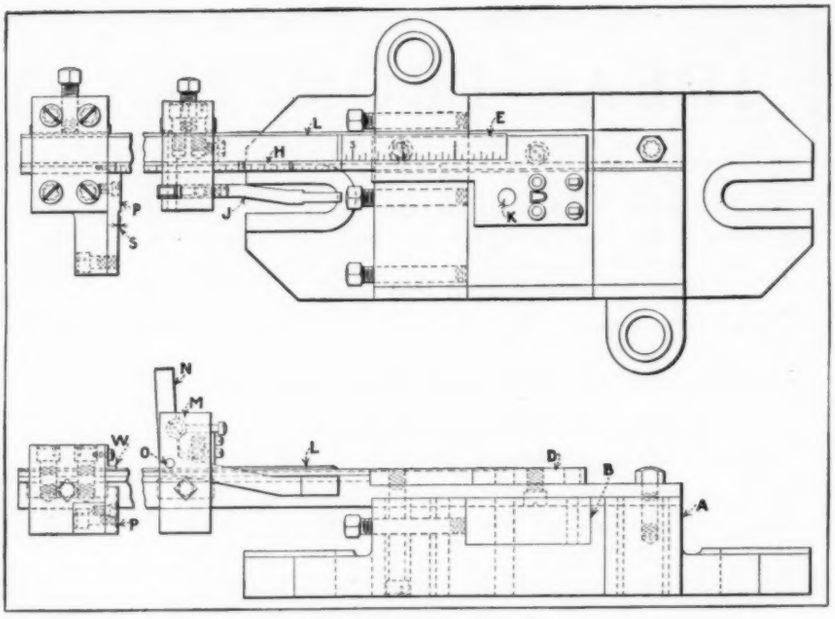


Fig. 2—The die and gages

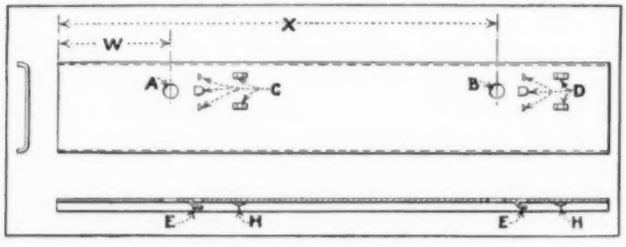


Fig. 3—The work

die bed without disturbing the other members, which is a great convenience for grinding and making replacements to the die.

By paying attention to such details as these, dies are made that will stand up day after day and produce good work, and the gaging features allow of punching different lengths of work having variable centers.

Smoothing Patterns With a File
Discussion

By Elton Sterrett

In the article under the title given above, on page 1025, Vol. 67, of the *American Machinist*, I assume that Donald A. Hampson refers to the use of a metal-cutting file, and not to one specially cut for woodworking. The old German artisan who taught me pattern-making, used files in place of sandpaper where flat surfaces were required, but he especially advised against the use of a file that, to quote Mr. Hampson's words, "has lost its original sharpness." A used file always shows its wear on the edges first, and tends to make a slightly hollowed cut—thus defeating its very purpose.

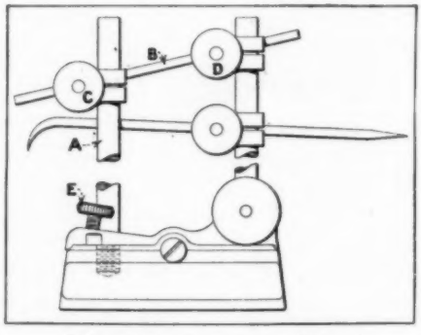
We always selected a new file, filling the teeth with chalk, as for filing soft metals, or, where an especially fine cut was required, plugging with babbitt metal and then setting the filling by going over the file with a hardwood block and a light hammer, driving the end grain of the block against the babbitt to expose the bare tips of the teeth. With such a file it was possible to remove the "nap" raised by shellacing a pattern without marring the finish beneath, or to make minute changes in contour without sacrificing the desired flatness.

Stiffening a Surface Gage

By George C. Warren

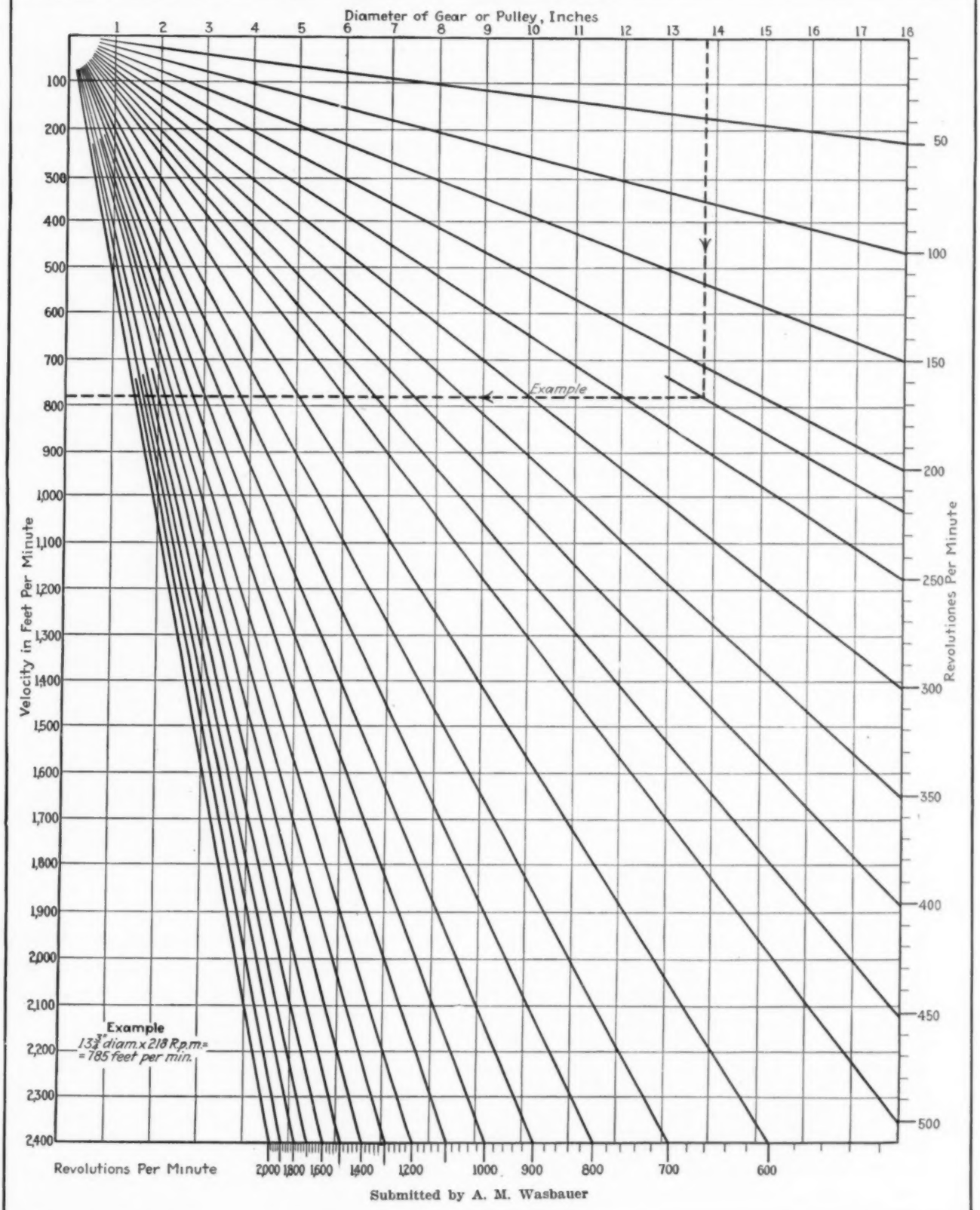
In laying out work with a surface gage when the scriber is at its extreme height, there is too much spring to permit accurate scribing. To remedy this defect, I made some additions to my gage, as shown in the illustration.

The base was drilled and tapped for the rod *A*, which was connected to the rod belonging to the gage by the rod *B*, by means of the clamp collars *C* and *D*. When adjusting the gage by the screw *E*, the clamp collars *C* and *D* are, of course, left loose enough to allow the rod *B* to slide therein, but not loose enough to permit them to drop down the vertical rods by their own weight. After the adjustment has been completed, the clamp collars *C* and *D* are tightened, confining the rod *B* between them and making of it a brace, tying the two vertical rods together.



How the gage was stiffened

Velocity Chart for Gears and Pulleys



Submitted by A. M. Wasbauer

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American Machinist

Editors: KENNETH H. CONDIT AND FRED H. COLVIN

Established 1877

A Good First Quarter

EVEN the most conservative of the business annalists are now admitting that the first quarter of 1928 has seen good business in most industries. In view of the February record for the steel mills, the stirring activity of most of the automobile plants and the satisfactory condition of the machine tool industry, it is hard to do otherwise.

April figures will not be available for some days, of course, but sentiment is still optimistic and what might be called the "opinion" analysis of the month indicates that April is not going to be far, if at all, behind March as a good business period.

The uneasiness occasioned by the unemployment discussions is the principal adverse factor, but its seriousness has probably been exaggerated. About the only definite conclusion that a disinterested observer can draw from all the talk and statistics is that we have no sure means of knowing how many people really are out of work. The odds favor the low estimates of the Secretary of Labor rather than the high ones of some members of the Senate, because the Secretary's estimates are based on a sampling survey. Neither estimate, however, seems to take sufficient account of the shift of labor to new industries, and for that reason neither one can be depended upon.

Business men, apparently, are no longer upset by presidential campaigns or wild stock speculation. They have ignored them so far this year and will probably continue to do so and build up a business record that bids fair to exceed that of 1927 and may even equal that of 1926.

Quantity and Cost

MASS production has made possible so many astounding achievements in manufacture that we are prone to credit it with magic powers. Builders of machines of any kind, in small quantities, dream of the day when larger orders will enable them to build in very large lots and so cut costs almost to the vanishing point. Generally this is a delusion that leads to disappointment and loss.

It is true that building in small lots is usually expensive. Manufacturing costs can generally be materially reduced by building in larger lots. But there comes a time, and frequently at a lower point than might be expected, when further increases in quantity fail to secure materially lower costs. Special machine equipment will frequently lower production costs on smaller quantities to a much greater extent than a mere increase in number.

Continuous production is a potent factor in securing minimum costs. Where tools and operators can be highly specialized costs can be materially lowered even without extremely large production. It is frequently better to run a small department continuously than to put through larger lots at infrequent intervals, because large production does not necessarily mean low costs.

Getting Facts for Management

ONE of the hardest parts of any manager's job is to place blame or to give credit where it really belongs. With the expert buck passer, the man with the ever ready alibi or the man who is sensitive about telling where the blame should actually rest, the manager needs more than the wisdom of a Solomon to get results and play fair with all hands. Frequently the few men who could give him the facts are distinctively averse to carrying tales, both because they dislike the rôle and because they know a tale bearer is always under suspicion. Knowing that these conditions exist the manager must find a way of getting the facts.

Brief conferences at regular periods, at which each department head can and must state the conditions of the work under way, have been found helpful in many shops. Delays, failure of work to go together, shortage of material, all come up automatically at such meetings. It does not take long for the keen manager to spot the buck passers and alibi experts and to give their testimony its proper value.

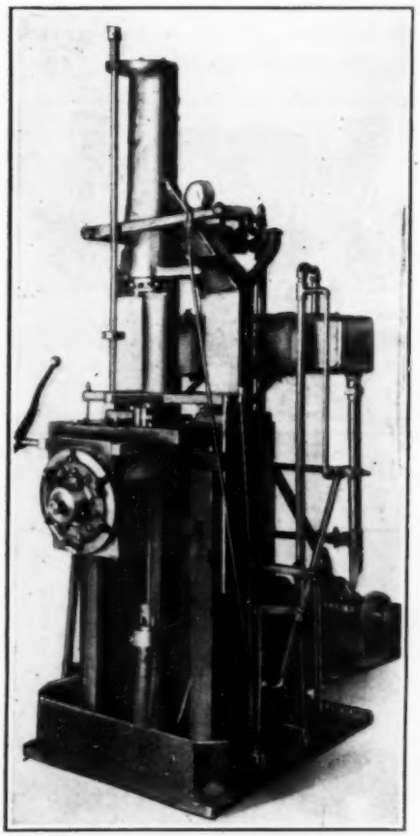
It is also necessary for the manager to discriminate between the man who is a natural tale bearer and the one who reluctantly and from a sense of duty tries to set matters right.

In a small town where jobs are few, what is the responsibility of a plant management when it becomes possible, through better equipment and methods, for the 45-cent girl to displace her 70-cent father, thus reducing the family income by the difference?

· SHOP · EQUIPMENT · NEWS ·

"American" Semi-Automatic Pull-Type Broaching Machine

SEVERAL classes of work may be handled on the pull-type broaching machine which has been developed by the American Broach & Machine Company, Ann Arbor, Mich. Arrangements of this machine include broaching a large plate, one hole at a time, or six holes at once in a smaller plate. When broaching single holes, work is slipped over the broach by hand. A pedal actuates the lower cylinder which moves upward and pushes the broach into the automatically-connecting head. The second pedal causes the pulling ram to start on its upward stroke. In one arrangement of the machine, the work drops onto the angular table and falls into the chute as soon as the broach passes through. However, at this point in the machine illustrated, the table is automatically released and swings back into the open position. In this type, after the broach has descended, the work may be indexed to the next hole. Upon completion of the upward stroke, the broach immediately starts downward. At a point 5 in. from the lowest position the broach is released from the holder by means of a latch. The lower cylinder recedes to its starting position. The machine is operated by hydraulic pumps and occupies a working space 5 ft. square and has a height of 9 ft. with the ram in its highest position.



"American" Semi-Automatic Pull-Type Broaching Machine with work fixture shown in the open position

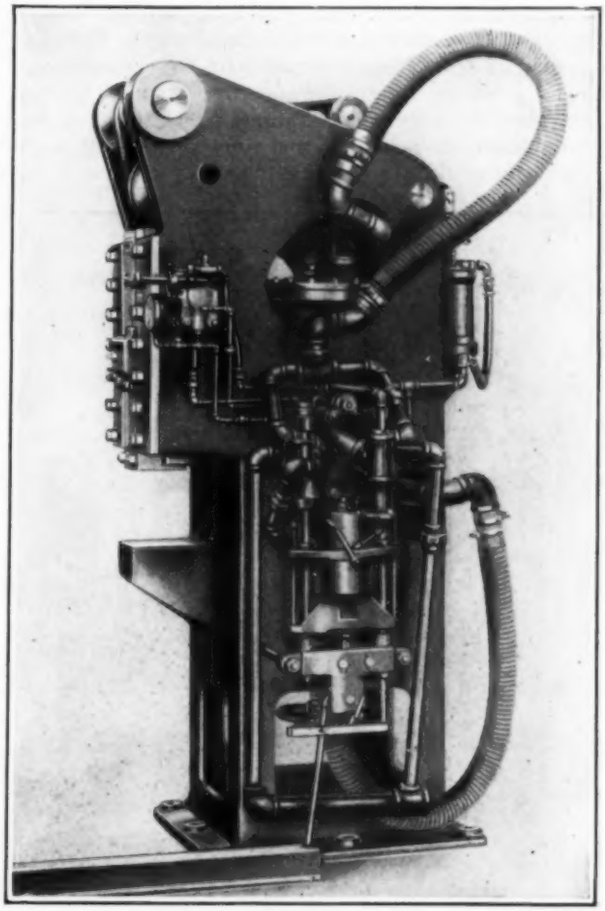
a production of 600 holes per hour can be reached. Multiple-broaching can attain a production of 2,160 $\frac{3}{4}$-in. holes per hour, and the floor-to-floor time is approximately 10 seconds. The machine illustrated will handle one hole at a time. This machine is similar to the V-50 vertical broaching machine described on page 671, Vol. 68, *American Machinist*, except that it is semi-automatic in operation.

When operating the machine, the

Hanna High-Speed Pneumatic Press

COINING, squeezing, forming, upsetting, shallow drawing, extrusion and punching comprise the operations that it is possible to perform with this high-speed pneumatic press which has been announced by the Hanna Engineering Works, Chicago, Ill. The press shown in the illustration will exert a pressure of 150 tons between dies at an air pressure of 100 lb. per sq.in. The machine is available in numerous styles and tonnages.

The air-cylinder piston unit actuates the ram by means of a toggle and lever mechanism. The toggles close the gap between the dies with little air consumption, while the lever exerts a uniform pressure on the dies through a considerable portion of the ram stroke, regardless of the thickness of the work. The stroke of the die or ram may be set for a wide range of lengths by adjusting a handwheel at the base of the press. The pressure exerted between dies may be set for anything between 20 per cent of and full pressure rating by adjusting a pilot-valve regulating spring. A known pressure which can be read directly in tons on a gage visible to the operator will then be exerted on



Hanna High-Speed Pneumatic Press

the work even though it vary in thickness.

A high speed of 30 to 40 cycles per min. is made possible through several features: Cushions absorb shock on both extremes of the piston stroke, while an air counterbalance prevents heavy impacts. The dies automatically lift upon completion of the down stroke. Only one die stroke cycle will result from each depression of the foot trip pedal even though it be held down, since the pedal is guarded against accidental depression. Adjustment of the dies simplifies die setting, and all shims less than ¼-in. thick are eliminated. This adjustment together with the stroke adjustment allows a minimum air consumption for the stroke requirement of each job. The return stroke is accomplished at less than one-tenth the air consumption of full-pressure working stroke.

Brown & Sharpe No. 13 Automatic Gear Cutting Machine

THIS No. 13 automatic gear cutting machine has been redesigned by the Brown & Sharpe Manufacturing Company, Providence, R. I., to increase its capacity and ease of handling. The machine has been made heavier throughout so that teeth of 4 diametral pitch may be cut in cast iron and 5 diametral pitch in steel. Spur and bevel gears, clutches, segments and other common jobs may be conveniently handled. The ease of set-up makes possible its use in jobbing shops, and on the other hand the convenience in operation reduces costs on production runs.

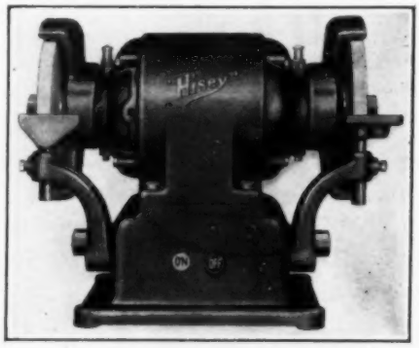
The cutter slide is of rigid construction with the counterweight arrangement integral with machine. The cutter slide has a maximum travel of 5½ in. and a minimum of ½ in., permitting the machine to economically handle small work.

The motor is mounted in the base of the machine and is completely inclosed thereby. Air is admitted to cool the motor through louvres placed at the front and rear of the compartment. Power is taken from the motor by means of a prestretched driving chain. Any slack in the chain may be taken up by adjusting the plate on which the motor is mounted.

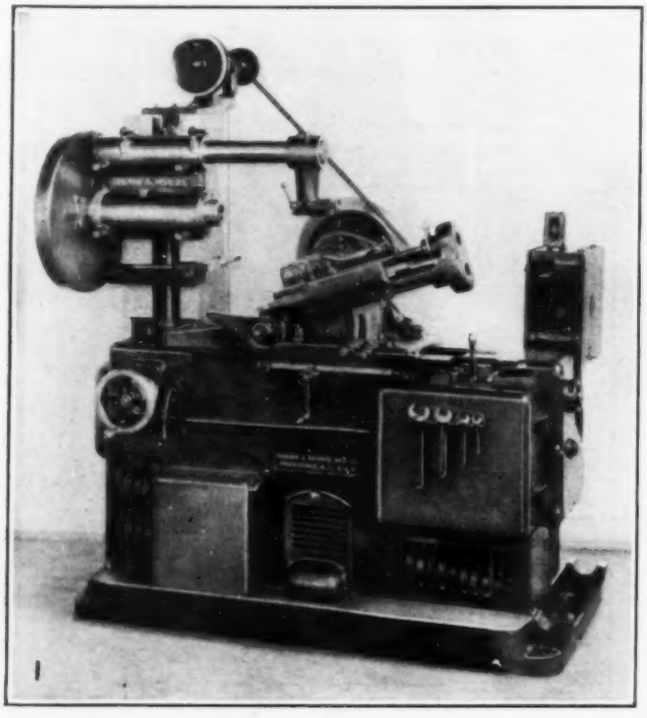
All parts of the machine may be quickly and easily lubricated by means of a simplified oiling system. Due to the general increase in strength and rigidity, the weight of the machine is approximately 4,000 pounds.

Hisey 6-Inch Two-Wheel Bench Grinder

This bench grinder, which is similar to that described on p. 981, Vol. 60, *American Machinist*, is being marketed by the Hisey-Wolf Machine Company, Cincinnati, Ohio. It will take wheels up to a diameter of 6 in., and is equipped with adjustable grinding rests, which can be removed. As in the previous machines, the spin-



Hisey 6-Inch Two-Wheel Bench Grinder



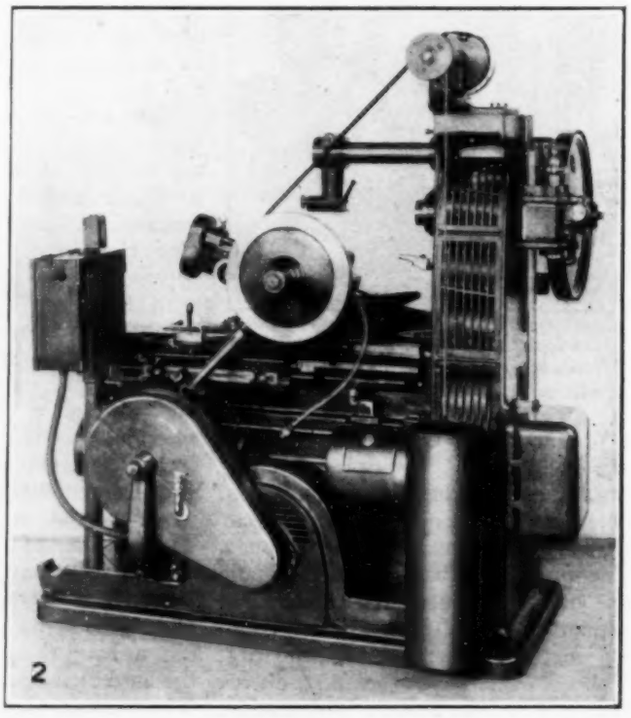


Fig. 1—Brown & Sharpe No. 13 Automatic Gear Cutting Machine. Fig. 2—Rear view of the machine

dles are completely inclosed, and are provided with felt washers for protection against dust.

As will be noted in the illustration, the motor switch is inclosed in the base and is actuated by push buttons which protrude through the wall. The usual ¼-hp. motor is mounted in ball bearings and is provided with brush holders having adjustable tension.

Pfauter Nos. FS 1 and FS a1 Hob and Cutter Sharpening Machines

THESE Pfauter Nos. FS 1 and FS a1 hob and cutter sharpening machines are being marketed in this country by O. Zernickow Company, 15 Park Row, New York, N. Y. The former machine is semi-automatic in operation while the latter, which is shown in Figs. 1 and 2, is fully-automatic. Both machines will grind spiral-fluted milling cutters from the smallest size up to 6¼ in. in diameter and 10¾-in. maximum grinding length, according to the diameter of the wheel and the shape and depth of the flute. These machines are adapted to grind hobs, form cutters, cylindrical cutters and reamers. The grinding dust is sucked up by an exhaust fan and deposited in a water tank in the base.

Both machines have several features in common, as follows: Either single-pulley or direct-motor drive may be obtained. In the latter case, the motor is located in the body of the machine and is inclosed by a flat plate in place of the plate carrying the pulley bearing with hinged pulley cover. The main drive shaft furnishes power to both the grinding-wheel and exhaust-fan shafts and also the knee and table of the machine. Automatic table travel is provided by a reversing device operated by two adjustable stops on the table. The shaft and spindle located in the table change their direction of rotation and thus traverse the table, the table spindle being supported in a nut. The spindle nut reciprocates in the cross-slide and its idle travel is limited on the left by a dead stop and on the right by an adjustable shoulder piece. A knob having a milled edge is placed at the back of the cross-slide, and provides for the adjustment of this shoulder piece to eliminate back lash. By means of this device the machines grind on the forward and on the return movements of the table. The work table of the machine runs on wide ways and is inclined. The cross-slide and table are arranged to swivel to an angle of 35 deg. The grinding-wheel spindle of either machine is hardened and ground and runs in adjustable, dust-proof, phosphor-bronze bearings. A special attachment is also included for the truing of the grinding wheel to any desired angle after the wheel cover is swung clear.

The manner in which the work is indexed constitutes the difference between the semi-automatic machine FS 1 and the fully-automatic machine FS a1. However, in either machine positive rotation of the cutter corresponding to the spiral-grinding flute is accomplished by means of a system of change gears. The semi-automatic machine employs hand-indexing from flute by means of an index plunger and plate. Similarly, the adjustment of the work to the wheel both on setting up and after each stroke of the table, is also effected by hand. On the fully-automatic machine, however, a second set of change gears governs the indexing, these being connected with the spindle movement through a stop and pawls.

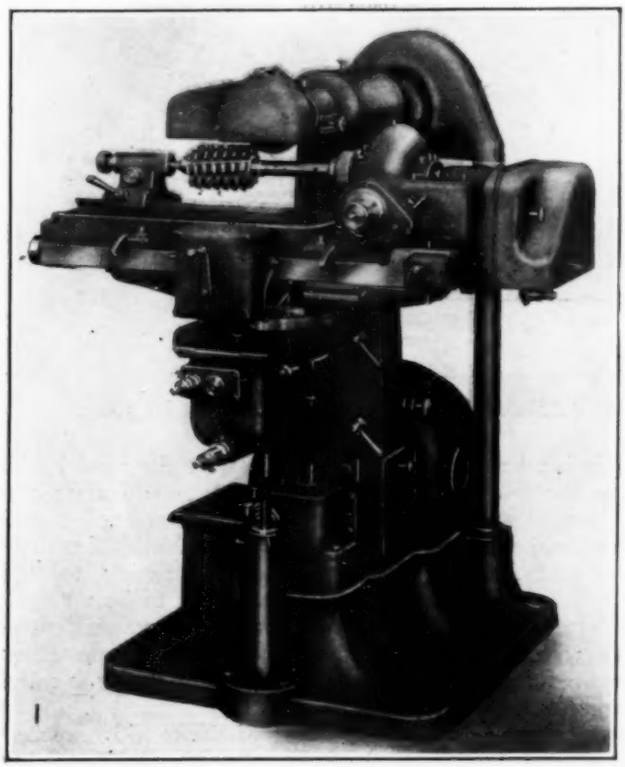


Fig. 1—Pfauter FS a1 Automatic Hob Sharpening Machine.

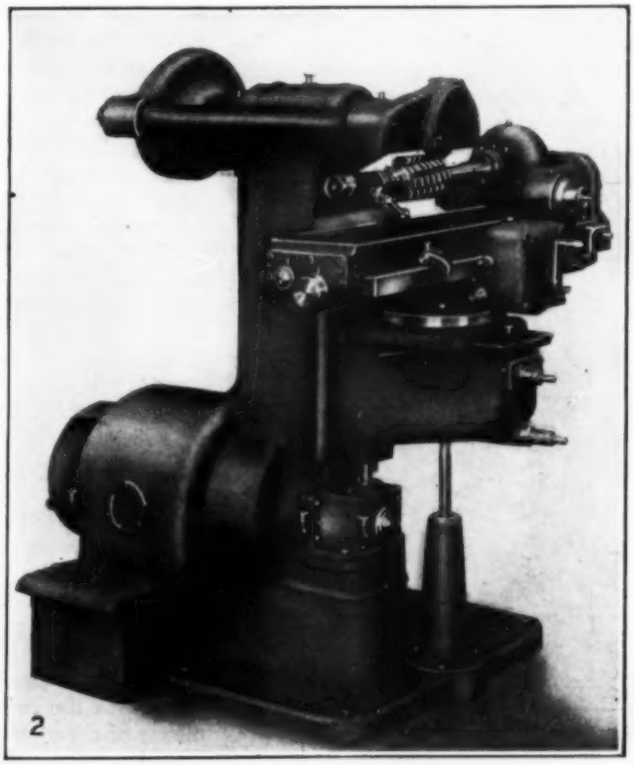


Fig. 2—Left-hand view of the machine showing belt drive

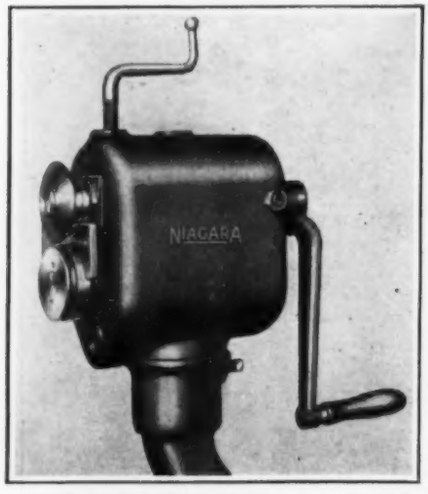
The indexing takes place after every forward and return stroke of the table, and hence all teeth of the cutter are finished uniformly. The feed per revolution of the cutter is adjustable according to the diameter and material of the work and the diameter of the emery wheel. Since in some cases it might be desired to perform all operations by hand, the automatic features may be disregarded.

SPECIFICATION OF MODELS FS 1 AND FS a1

Longitudinal movement of the table, in.	13 1/16
Cross adjustment of table, in.	4 1/2
Vertical adjustment of table, in.	5 7/8
Maximum distance from grinding spindle to dividing head spindle, in.	6 1/2
Angular movement of table each side of parallel, deg.	35
Maximum distance between centers, in.	16 3/8
Maximum length to be ground, in.	10 1/4
Maximum diameter ground between centers, in.	6 1/16
Length and width of table, in.	37 1/2 x 11 7/16
Maximum grinding wheel diameter, in.	5 7/8
Grinding wheel spindle, r.p.m.	3,400
Motor, hp.	2
Motorspeed, r.p.m.	1,000
Weight FS 1, lb.	1,960
Weight FS a1, lb.	2,030
Floor space, in.	63x63

Niagara No. 147-C Heavy Combination Bench Machine

For performing burring, turning or wiring operations on soft-steel sheet metal up to 18 gage, this No. 147-C heavy combination bench machine has been marketed by the Niagara Machine & Tool Works, Buffalo, N. Y. It is similar to, but larger than, the company's No. 131-C machine described on page 794, Vol. 67, *American Machinist*. The device can be set up quickly on any workbench.



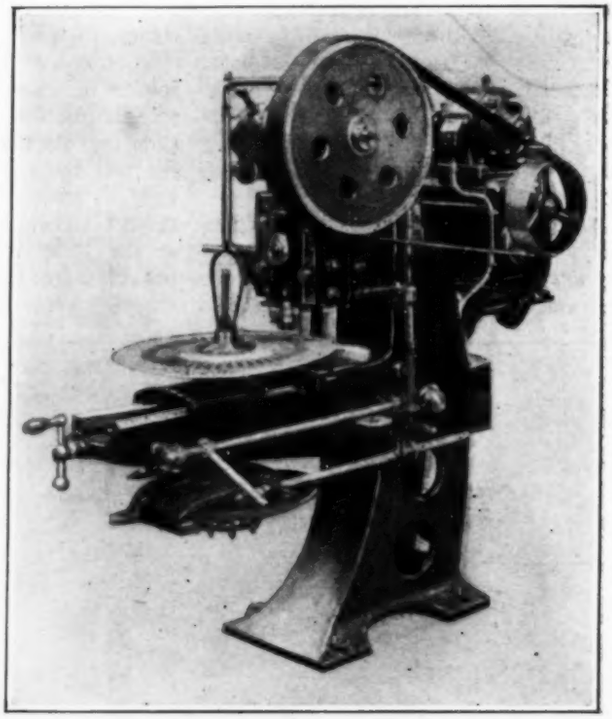
Niagara No. 147-C Heavy Combination Bench Machine

The machine is arranged with back gearing and has a one-piece inclosing frame which combines safety for the operator and long life in service. The rolls are made from steel, hardened and polished, and are easily removed. Three interchangeable rolls have been designed for the single operations of burring, turning or wiring soft-steel sheets. Rolls of one type are shown in the accompanying cut.

The machine is furnished complete with three pairs of rolls and is mounted on a heavy bench stand. However, it may be supplied as a single-purpose machine with but one set of rolls for the work demanded.

Schuler High-Speed Automatic Notching Machines

ABILITY to punch 600 notches per minute, one at a time, is claimed for the five sizes of the Schuler high-speed automatic notching machines distributed in this country by J. I. Bernitz, 25 Beaver St., New York, N. Y. This machine is intended for the notching of rotor and stator laminations from 10 to 59 in. in pitch-circle diameter. The practice of notching is as follows: A disk equal to the diameter of the stator with a center hole is produced, and the slots for the stator notched from a common center. By means of special dies the inner part serving as the rotor may be cut out simultaneously and notched separately. Either internal or external notching may be done on this machine. The frame is a hollow casting with a protruding saddle. It is amply dimensioned so that smooth and accurate work results and springing at the highest admissible strain is precluded. The impacts caused by the quick action of the lifting mechanism are absorbed by the frame without any influence on the parts actuating the dividing gear.



Schuler High-Speed Automatic Notching Machine

The machine may be driven by a Norton gear box having ten speeds for the three smaller sizes and eight speeds for the two larger sizes, or by means of a variable-speed motor. The gear box or motor is mounted on a cylindrical arm at the rear of the machine, a belt driving the flywheel.

The slide moves in long adjustable pneumatic guides, and also may be moved vertically. The throwout of the slide, after a circle has been completed, consists of a locking segment built integrally with the slide itself.

The lengthened table carries the saddle stock on pneumatic guides and is set by a spindle with Nonius division and lever according to the diameter of the disk to be notched. The whole dividing apparatus is suspended from this saddle terminating on top in the fixing device for the disks.

The fixing of sheets to be notched on the two smaller machines is quickly

done by means of a bayonet lock. On the larger machines, an electromagnetic fixing device is provided. The electromagnet is suspended from a spiral spring and is adjustable horizontally according to the diameter of the disk to be notched. The current for the magnet is conducted along the sliding adjustment and through the spiral spring.

To obtain an accurate feed of the larger sizes of machines during the notching process an arresting cone is actuated by a cam. This cam is so placed in relation to the feeding cam that at the beginning of the return movement of the feeding cone, the arresting cone enters a tooth space of the dividing disk, thereby regulating the dividing mechanism and stopping it before the operation begins. With the smaller type of machine, for sheets up to 24 in. in pitch-circle diameter, no arresting cone is used, the feeding mechanism being so constructed that the feed pawl acts as arresting pawl.

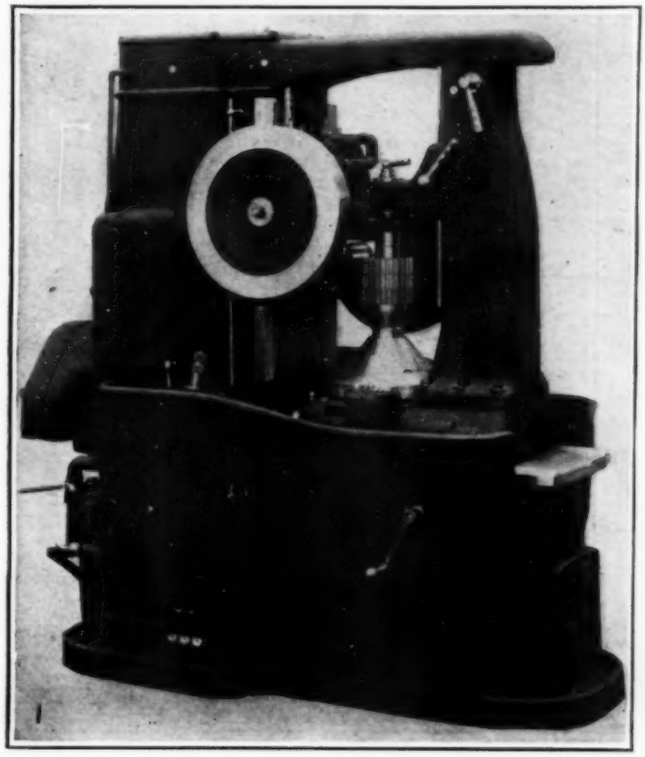
The regulation of the feeds is effected by shortening or lengthening the two lifting levers, which can be easily adjusted by clamping rings and nut. The power required by these machines varies from ¾ to 3 hp., while the weight varies from 900 to 3,600 pounds.

Pfauter R.I.H. High-Production Gear Hobber

THIS special-purpose Pfauter hobber has been introduced into this country by the O. Zernickow Company, 15 Park Row, New York, N. Y. Although the working range of this machine is somewhat limited, it will take a variety of work as is evidenced by the fact that spur gears up to 12 in. in diameter and having 5 D. P. may be cut with a maximum hobbing width of 8 in. In Figs. 1 and 2, front and rear views of the hobber are shown.

The machine may be operated quickly and simply. When the stops for the automatic travel of the hobbing saddle are set and the table is set in for the correct depth of tooth, the table carriage is locked in its correct position on the bed by a single handle. These operations are only necessary when changing over to cut a different gear, and hence but seldom occur on mass production. To change over from gang to gang, it is only necessary to release the arm of the work-arbor support, replace the work arbor loaded with finished gears by one loaded with blanks, retighten the support arm and engage the feed.

The work is mounted conveniently and rigidly on a vertical work arbor. Chips and coolant thus fall clear of the hob and work and the machine ways keep clean as can be seen by Fig. 2. The work-arbor support is solidly connected with the machine column and makes, with the latter and the bed of the machine, an inclosed rectangle which withstands all stresses without harmful distortion, it is claimed. The horizontal arm of the work-arbor support has a movable center. These two features of the arbor support permit working with interchangeable work arbors. Thus, during the time that one gang of blanks is being hobbed, the next gang is being mounted on the spare arbor ready for putting on the machine. By this arrangement the loading time is reduced materially. The hob is driven through spur and bevel gear-



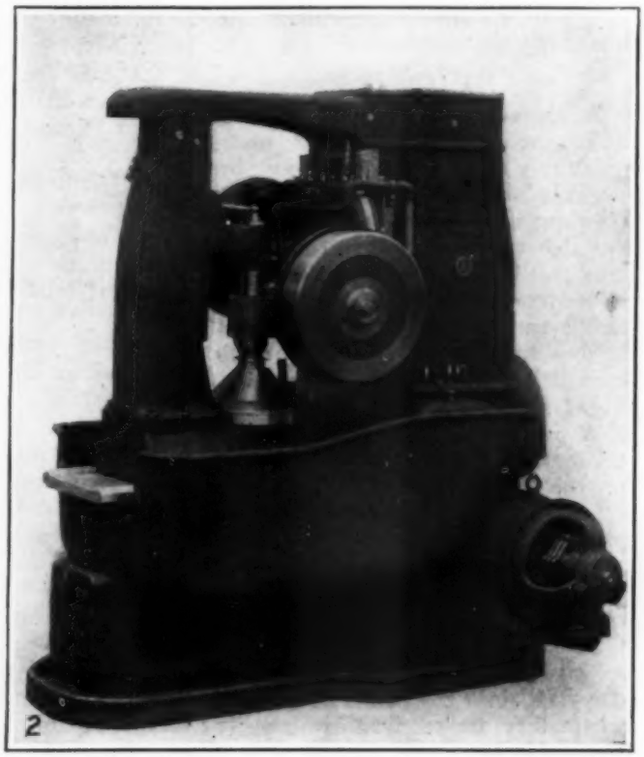


Fig. 1—Front view of Pfauter R.I.H. High-Production Gear Hobber. Fig. 2—Rear view of the Pfauter Hobber showing work arbor and motor drive

ing and a spline-shaft to the hobbing saddle. An internally-toothed gear cut in the fly-wheel drives the hob spindle direct. Hob speeds of 62, 89, 125 and 175 r.p.m. are attained through change gears.

The hobbing head carries two superimposed shafts, hardened and ground, the axially adjustable hob spindle and the hob-drive spindle. Each of these shafts carries at its outer end a large flywheel to equalize the torque on the hob spindle, Fig. 1. The hobbing head is provided with a swiveling movement 5 deg. each side of the horizontal so that it may be set according to the lead angle of the hob. The overhang between hob spindle and vertical slide is reduced to a minimum to reduce vibration. The hobbing saddle slides on prismatic ways on the upright and is provided with taper strips for adjustment. The hobbing saddle is balanced by a counterweight.

The dividing-gear drive runs in an inclosed dust-proof oil bath. It consists of a wormwheel and a worm, hardened and ground all over, which is adjustable both axially and radially. The rates of hob feed are from 0.028 in. to 0.236 in. in many steps. The speed may be instantly changed while the machine is running, by means of a single lever without the use of any change gears.

Saddle Has Quick Return

At the end of the cut the hobbing saddle returns automatically at a quick rate to its starting position, by special motor drive. The reversing positions for this travel are set by movable stops according to the hobbing width and nature of the work. This quick power traverse of the hob saddle can also be effected by hand at any time by means of a switch mounted on the center of the machine. Fig. 1 shows the switch at the left.

A powerful coolant pump with a delivery of about 7 gal. per min. is provided to keep down the heat generated on high production. This pump can be put out of operation when desired. For the collection and removal of the large quantities of chips and lubricating oil, the machine table is of conical design and large splash guards are provided. The chips fall into the inside of the bed where they are received in an easily removable bin.

The main shafts of the machine run in ring-oiling bearings. Other important points are furnished with oil by central lubrication. For this purpose a pump is provided on the operating side of the machine and is fed from a tank in the top of the column. This pump is worked from time to time until the resistance indicates that all the oil pipes are filled. From the pump the oil goes to a distributor with different-sized air vessels which pass the oil on, when the pump is not working, according to the requirements of the various oiling positions.

Specifications

Maximum spur gear diameter hobbed, in.	12
Maximum face of spur gears hobbed, in.	8
Maximum diametral pitch in chrome-nickel steel	5
Diameter of work table, in.	13¾
Diameter of hole in table, in.	1⅛
Minimum axial distance between hob arbor and work arbor, in.	2
Maximum axial distance between hob arbor and work arbor, in.	9¼
Maximum hob diameter, in	5¼
Maximum hob length, in.	5 5/16
Maximum movement of hob, in.	¾
Diameter of hob arbors, in.	1⅛ and 1¼
Diameter of work arbor, in.	1⅛
Motor size, hp.	8
Motor, speed, r.p.m.	1,500
Floor space, in.	28x60
Net weight of complete machine, lb.	5,300

Seguin "Stroborama" Stroboscope

THE means of making an analysis of the motion of mechanisms that develop faults in operation, though perfect in design when at rest, through direct observation that retains true relationships between shape, size, reliefs and depths, are available in the Seguin "Stroborama" stroboscope marketed in this country by Musa-Hartzell-Du Casse, Inc., 25 West 43rd Street, New York, N. Y. The device permits observations to be made from any position with respect to the mechanism being examined. Further, it is not limited in scope since either a locomotive or a watch may be examined with equal facility for any length of time. The device has found use in automotive research, machine tool operation study, and design of small machinery. The Neon lamp used produces an illumination of 1,000 cp. which is projected by a reflector in such a manner that the powerful red light is diffused evenly over a large area. It is claimed that the intensity of illumination provided is such that any other illumination present either in factory or laboratory is entirely obliterated upon the area considered. This fact, together with the ease of securing power at 110 or 220 volts at 60 cycles permits this portable instrument to be operated on many different locations. The power consumption is 1½ kilowatts.

A rotary contact *Sy*, Fig. 2, constituting the synchronizer, produces the discharge of the low capacity condenser, charged to a few hundred volts by a continuous-current generator M_2G, in the primary winding of a high-frequency transformer, which raises the tension to that neces-

Fig. 1—Front view of the Seguin "Stroborama" Stroboscope showing its relative size, and also the independent synchronizing control

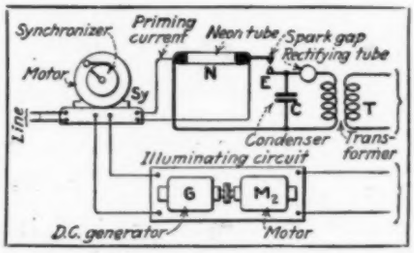


Fig. 2—Circuit diagram of the Stroborama

sary for the passage of the current in the rarefied gas tube *N*. This discharge by reason of the low capacity on the condenser very incompletely illuminates the tubes, and only serves to "prime" the illuminating current.

The source of illumination is derived from a powerful battery of condensers, which is constantly maintained in a state of charge. Alternating current for the power source is raised to the voltage required for illuminating the Neon tube by a transformer *T* and changed to direct current by means of a rectifier tube *S*. To discharge through the Neon tube *N*, the current must jump through a spark gap *E*, adjusted so that the resistance of the gap, added to the resistance of the Neon tube does not permit the condenser to discharge.

When the priming current passes through the Neon tube, it reduces the resistance of the system and the condenser discharges through the gap and through the tube, producing an intense light flash and one of such extremely short duration that parts of mechanism moving af a linear speed or peripheral speed of 350 ft. per sec. appear with sharp and distinct contours and without any distortion of form or size. Fig. 3 shows a propellor tip revolving at a peripheral speed of 160 ft. per sec. and the news print can be read distinctly.

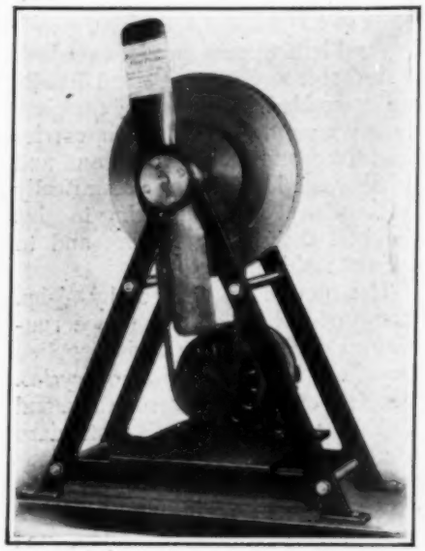


Fig. 3—Propeller tip having a peripheral speed of 160 ft. per second as it appears under light of the Stroborama

This general arrangement gives almost unlimited power of illumination, for it depends only on the illuminating source, and the illuminating current does not pass through the synchronizer. This synchronizer is independent of the mechanism being studied. It not only saves the lengthy and tedious labor of effecting connections but it makes it possible to show the mechanism not merely standing still, but also with a continuous forward and backward movement at any desired speed.

General Electric "Across-the-Line" Switch

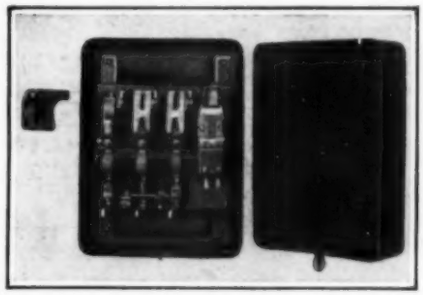
Squirrel-cage motors may be thrown directly across the line when this magnetic switch is employed, or it may be used as a primary switch for a wound-rotor motor, the secondary of which is handled by a drum controller. The device has been introduced by the General Electric Company, Schenectady, N. Y., and bears the designation of CR-7006-D-31.

This switch consists of a magnetically-operated contactor of the triple-pole, restricted-blowout type with normal open interlocking and two hand-reset temperature-overload relays, all mounted on a molded base and inclosed in a drawn shell case. It is designed for use on standard voltages and frequencies and the maximum horsepower ratings are as follows:

	Horsepower	
Volts	2 or 3-Phase 3-Wire	2-Phase 4-Wire
220	50	60
440	100	125
550	125	150
600	125	150

Overload protection is provided by two temperature-overload relays. The operation of either or both relays will trip the contact mechanism so that all phases of the motor are properly protected.

The switch is ordinarily operated by means of a start-stop push-button station of the momentary-contact type



General Electric CR-7006-D-31 Across-the-Line" Switch

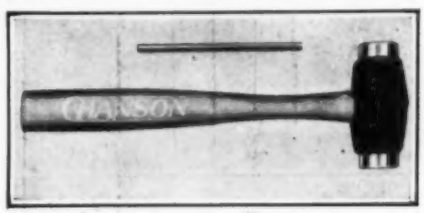
and with an extra pole on the magnetic contactor to provide an electrical interlock for the holding circuit. If such a push-button station is used and the voltage fails the contactor will open and will not close automatically on return of voltage but the "start" button must be pressed to restart the motor. If desired, the switch may be controlled from several places by installing a suitable number of push-button stations.

When the switch is used to handle the primary circuit of a wound-rotor motor in connection with a secondary drum switch, the push-button station is not required as provision is made in the switch for closing the contractor-coil circuit as the switch handle is turned to the first point and to open it in returning the handle to the "off" position. Such a combination provides under-voltage protection.

The switch may also be operated by means of any master switch of the single-pole, single-throw type, such as knife switches, pressure switches and float switches.

Chanson Soft-Faced Hammer

Five sizes and seven styles are available of this soft-faced hammer manufactured by the Chanson Division of the Illinois Iron & Bolt Company, Carpentersville, Ill. Either copper, steel or babbitt plugs may be



Chanson Soft-Faced Hammer

used in these hammers which vary in weight from ¾ to 8 lb. and in length from 10 to 24 in. These plugs are machined to a press fit in the steel body of the hammer head. They may easily be removed with a drift pin when replacement becomes necessary. It is claimed that the hammer will not lose its balance when such plugs are used. The tool is intended for use by mechanics when assembling or dismantling machinery.

Mahan Horizontal Combination Drilling and Tapping Machines

HIGH production on drilling, tapping, threading, counterboring, inserting screws, heading over rivets and other operations is made possible by these horizontal combination machines which have been developed by C. B. Mahan, 162 Longview Terrace, Rochester, N. Y. The machines were originally designed for use in the plant of the F. A. Smith Manufacturing Company, Inc., Rochester, N. Y., but can be modified for general use. Both bench and floor types of two-spindle machines are built, and a single-spindle bench machine is also available. In all types the horizontal spindle is fed forward by a yoke actuated by a foot pedal. By means of this mechanism and suitable jigs it is possible to tap to definite depths, the tap automatically reversing the machine when it bottoms.

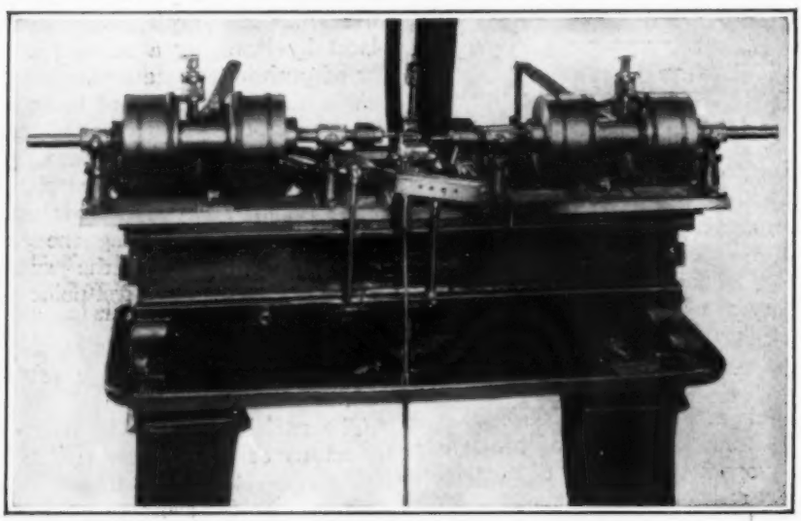


Fig. 1—Mahan Combination 2-Spindle Drilling and Tapping Machine of the floor type

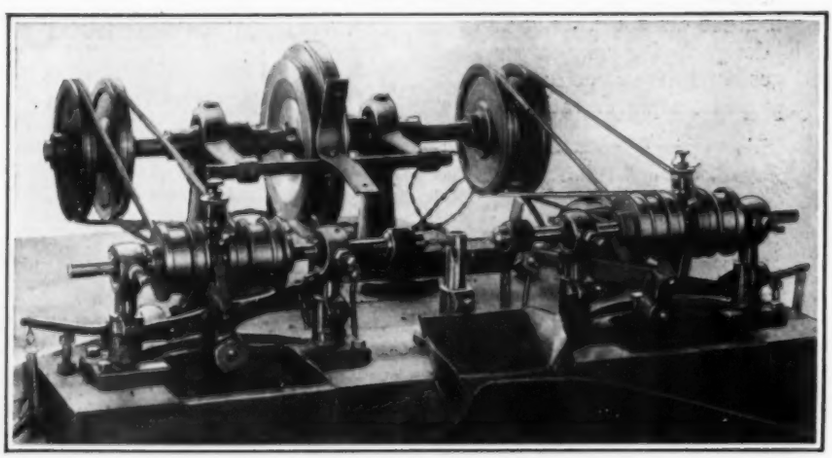


Fig. 2—Combination 2-Spindle Drilling and Tapping Machine of the bench type

The difference between leads and cutting speeds of the various taps used is controlled by means of a spring.

Model 1, shown in Fig. 1, is a combination two-spindle machine of the floor type. The chucking arrangement is automatic and grips the pieces before the tool engages it.

Model 2, illustrated in Fig. 2, is a miniature of Model 1, but has a much higher speed. It is claimed that in daily production over 3,400 No. 4 holes, 36 threads per in., were tapped per hour, while 4,400 holes of this size were drilled per hour. It is further claimed that the machine will tap within one-half a thread and that tap breakage is small. When the chuck was equipped with a die holder, both ends of a small crank were threaded at the rate of 1,500 pieces per hour. On this two-spindle machine equipped with one drill and one tap, it was possible to handle 1,200 holes per hour. Furthermore, it is possible to drill a ¼-in. hole next to a smaller hole with but a $\frac{1}{32}$-in. wall between them. The Model 3 machine represents one-half of the Model 2 machine.

Coates "Senior AA Flexishaft"

Three speed ranges are incorporated in the "Senior AA Flexishaft" presented by the Coats Clipper & Manufacturing Company, Worcester, Mass. Screw driving may be done at the lowest speed of 900 r.p.m. while at 1,725 and 3,450 r.p.m. grinding and buffing may be accomplished.

A cast-iron base, yoke and handle are assembled to make the complete motor mount. The handle carries the motor and three-speed cone and spindle, the latter being eccentrically set in a sleeve with a spring to give the belt the proper tension and to facilitate shifting.

The device is driven by ¼-hp. motor of the single-phase type running at 1,725 r.p.m. It is supplied from a 110-volt source at 60 cycles. Ten feet of rubber-covered cable and a plug are furnished as standard equipment.

The shaft consists of 4 ft. of high-carbon steel cable shaft, ⅜ in. in diameter, covered with a black japanned metalic casing ¾ in. outside diameter. The outside end connections are nickel plated. The handpiece has a

Coates "Senior AA Flexishaft"

knurled grip and ball-bearing spindle. The spindle nose has a $\frac{5}{8}$-in. thread, 18 threads per in., for a chuck or other connection. The net weight of the device is 62 pounds.

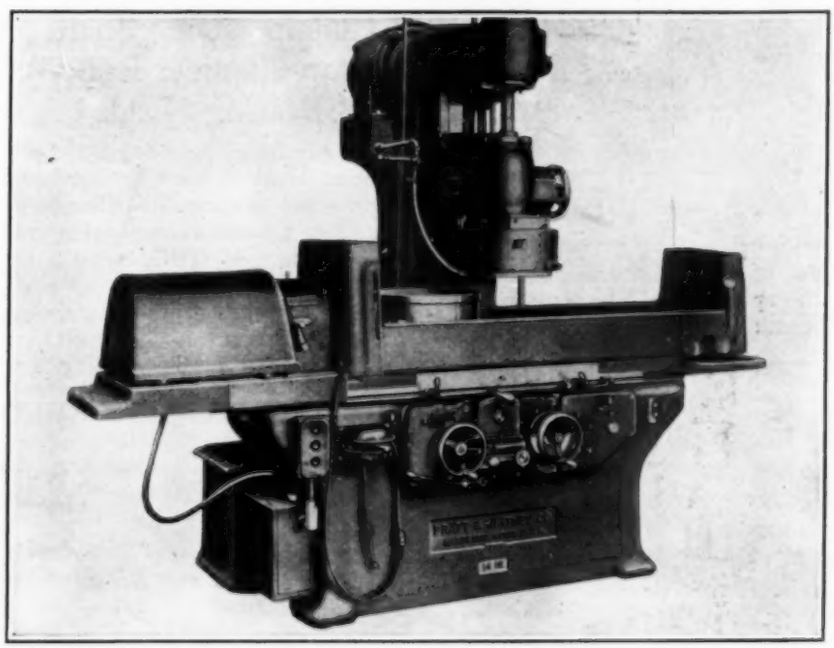
Pratt & Whitney Rotary Chuck for Vertical-Spindle Surface-Grinding Machine

The Pratt & Whitney Company, Hartford, Conn., has brought out a power-driven rotary chuck to be attached to the traversing table of its 14-in. vertical-spindle surface-grinding machine, by which that machine is convertible temporarily into a rotary surface grinder. It is an entirely self-contained unit, and is attached by bolting it to the planed end of the regular machine table in such a manner that the chuck and its immediate driving mechanism is supported by the table while the motor by which it is driven overhangs the table to the left.

No change in the machine is necessary to adapt it to the reception of the rotary chuck except to remove the water guard at the left end of the table. The housing of the chuck and its attachments is so designed that when in place it substitutes for the removed guard, and completely incloses that end of the table.

The chuck is driven by a variable-speed motor through a worm and wormwheel. A suitable control box is provided to obtain the desired range of rotative speeds. The regular traverse feeds of the grinding machine may be used to traverse the chuck back and forth under the grinding wheel, or the table may remain stationary while the grinding wheel is fed vertically by hand.

When desired, the regular feed mechanism of the surface-grinding machine can be so modified as to provide a rapid run-out on completion of the job, and to return the table with equal rapidity when a new piece is loaded on the chuck. Either mechanical or magnetic chucks may be used.



Rotary Chuck applied to Pratt & Whitney Vertical-Spindle Surface-Grinding Machine

Zeiss "Projection Optimeter"

Mass inspection is facilitated by means of a visible reading scale recently incorporated in the Zeiss "Projection Optimeter" marketed in this country by the George Scherr Company, 142 Liberty Street, New York, N. Y. This construction has been accomplished by a change of the optical tube allowing a lamp holder as well as a screen attachment to be fitted to it as shown in Fig. 1. In this way the image of the scale as it is formed in the ocular is transmitted through a set of prisms and projected upon the screen as shown in Fig. 2. Observation of the reading on the screen is available to two or more persons at the same time so that checking measurements is possible.

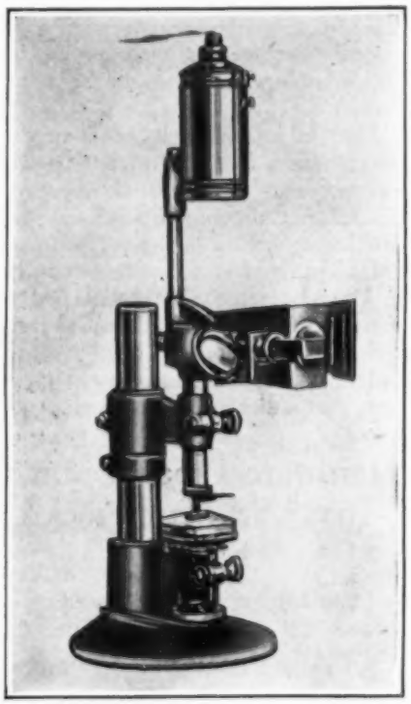


Fig. 1 — Zeiss Projection Optimeter showing the screen attachment and lamp holder

The transfer of the image to the screen is obtained without impairing the accuracy of the instrument since it is obtained by purely optical means. The graduation of the scale is in 0.00005 in., and 0.00001 in. may be estimated easily. Other improvements embodied in the new design are a table with a serrated instead of a

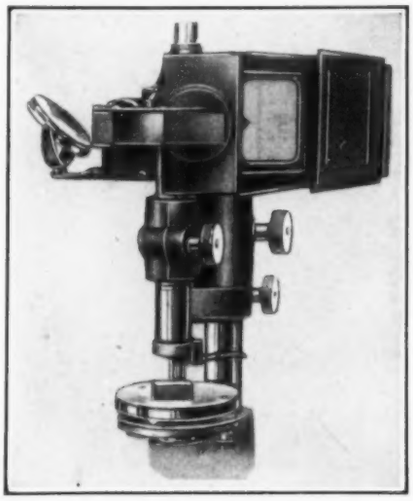


Fig. 2 — Screen attachment showing rapid visible reading possible which is to 0.00001 inch

smooth surface, as well as an increased range of scale to ± 0.005 inch.

Due to its simplicity and rugged construction, this projection Optimeter enables unskilled operators to make routine inspection of such articles as ball bearings, typewriter parts, gun parts, and other quantity products. It also has been used in the manufacture and control of precision gage blocks, reference standards, working and inspection gages, taps and other accurate work.

Hardware Products Company Standard Stock Knurls

Standardized sizes and patterns of knurls enable the Hardware Products Company, 103 Richmond Street, Boston, Mass., to make immediate delivery from a comprehensive list, some of the items of which are shown in the illustration. A special alloy steel containing high percentages of chromium and tungsten is used that becomes very hard on heat-treating without developing brittleness. The teeth are formed by means of hobs so that they are sharp and uniform. The heat-treatment is carried out in electric furnaces and the hardness is checked by means of Rockwell tests.

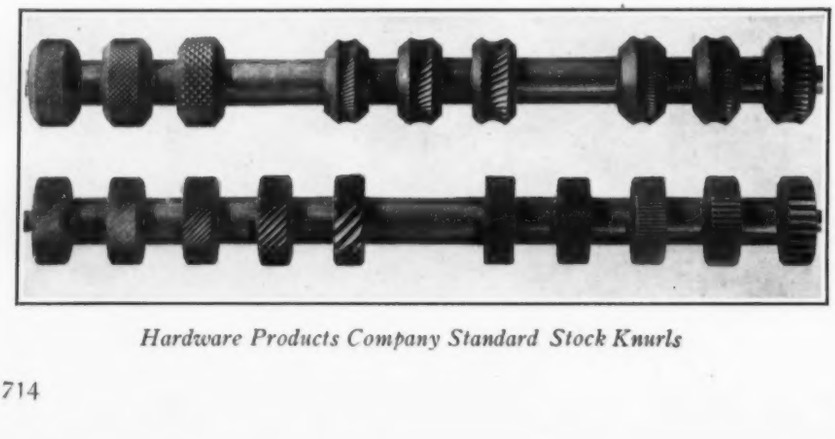
Black & Decker Electric Glue Pot

This compact electric glue pot of two-quart capacity has been developed by the Black & Decker Manufacturing Company, Towson, Md. A thermostatic control maintains the glue at a temperature of 150 deg. F. so that the best working consistency for smooth tight joints is always available. The heating element is made from Nichrome ribbon wound on mica plates and is tightly sealed.

The glue container is an aluminum casting machined to fit an iron receptacle in such a manner that heat is

Black & Decker Electric Glue Pot

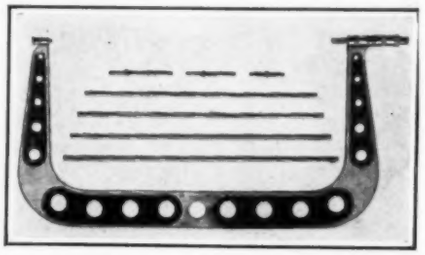
conserved as far as possible. The sides of the pot are sloped to minimize spillage, and a heavy iron wiper prevents waste from drippage.



Hardware Products Company Standard Stock Knurls

Brown & Sharpe Nos. 90, 91 and 92 Micrometers

These three micrometer calipers, Nos. 90, 91 and 92, are manufactured by the Brown & Sharpe Manufacturing Company, Providence, R.I. They have a combined range of 12 in. covering all sizes from 12 to 24 in. by thousandths. The range of measure-



Brown & Sharpe No. 91 Micrometer

ment of each tool is obtained by four interchangeable anvils of different lengths. These anvils can be changed easily and quickly and are held positively in place by a knurled nut. The anvil cannot revolve, but remains in one position, assuring accurate alignment with the spindle. Each anvil has means of adjustment for wear. All three calipers have clamp rings and are furnished with a set of four standards each.

Chambersburg Board Drop-Hammer Roller-Bearing Heads

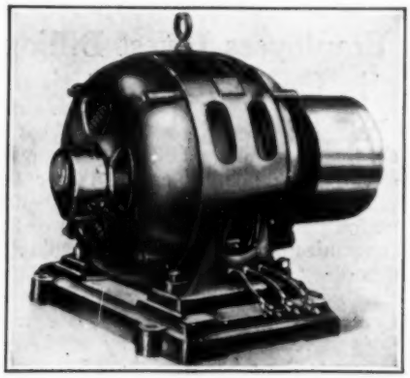
Roller-bearing heads have been announced by the Chambersburg Engineering Company, Chambersburg, Pa., for use as optional equipment on the rolls of the board hammers of its manufacture. One of these roller-bearing heads is shown in the illustration. It is claimed that the use of these heads not only per-

Chambersburg Roller-Bearing Heads for board drop-hammer

mits a considerable saving of power, but also causes a better maintenance of alignment and the elimination of interruptions of operation for oiling and changing bushings. It is further claimed that instead of the usual oilings twice daily these roller-bearing heads may be packed so that good lubrication is insured over long periods.

Triumph "Across-the-Line Start" Motors

These Type A "Across-the-Line Start" squirrel-cage motors are manufactured by the Triumph Electric Corporation, Cincinnati, Ohio, and are available in sizes ranging from 1



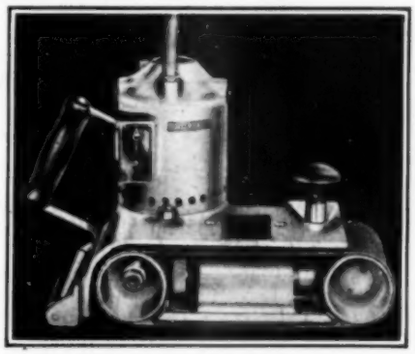
Triumph "Across-the-Line Start" Motor

to 30 hp. They are suitable for automatic push-button control installation and will develop 150 per cent full-load torque at starting without drawing current in excess of the limits allowed by the National Electric Light Association regulations. These motors are equipped with Timken roller bearings, but may be furnished with either ball or sleeve bearings.

Porter-Cable "Super Take-About" Sander

A smooth finish without ripple marks is obtainable, it is claimed, by means of this hand-belt machine that has been announced by the Porter-Cable Machine Company, Syracuse, N. Y. It is suitable for finishing slate and stone, floors, furniture, etc. Slightly-curved surfaces may be sanded by means of flexible pads, and belts can be furnished for cutting either wood or metal.

The machine is equipped with a 1-hp. motor of the universal type for



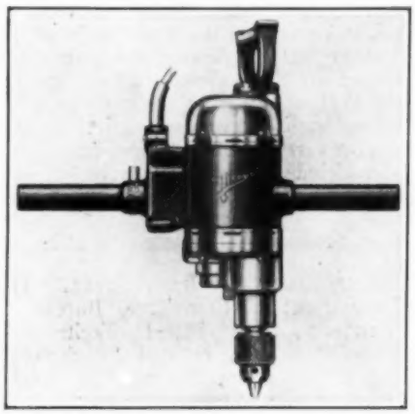
Porter-Cable "Super Take-About" Sander

use on either 110 or 220 volts, a.c. or d.c. Abundant power is derived to drive a 4x27-in. belt at 2,000 ft. per min. The rear pulley is driven by a worm and gear which are totally inclosed, thus sealing them against dirt. The equipment includes six belts, felt-covered shoes and 15 ft. of rubber-covered cable with duplex plug.

Hisey ½-Inch Electric Drill

The ball bearings of this ½-in. portable drilling machine, manufactured by the Hisey-Wolf Machine Company, Cincinnati, Ohio, are fitted in a way to eliminate slip and creeping action which are detrimental to the motor and other moving parts. Furthermore, the spindles, which are of large size, are hardened and ground where necessary.

As in the larger machines, the brush

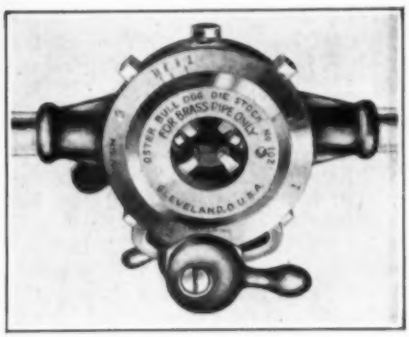


Hisey ½-Inch Electric Drill

holders have adjustable spring tension and are mounted as a separate unit on a Bakelite yoke, thus permitting brush adjustment when necessary.

Oster "Bull Dog" Die Stock

Automatic, quick-opening dies constitute the most important feature of the "Bull Dog" die stock which has been recently announced by the Oster Manufacturing Company, Cleveland,



Oster "Bull Dog" Die Stock for Cutting Threads on Brass Pipe

Ohio, for use in cutting threads on brass pipe. Such dies eliminate the necessity for backing-off the tool over the finished thread, a practice which is especially apt to ruin them when cut on brass pipe. The dies have been ground for cutting brass, and they may be quickly adjusted to cut either deep or shallow threads.

Trade Catalogs

BELT DRIVES. Alexander Bros., Philadelphia, Pa. has issued a pamphlet entitled "Tentacular Belt Drives." The bulletin contains notes on how to design such belt drives and how to make installations. Failures and remedies for such drives are discussed. Tables of the horsepower ratings are included. Several photographs show typical machinery using this type of belt. The catalog contains 16 11x8-in. pages.

DIE CUSHIONS. The Marquette Tool and Mfg. Co. has published a book entitled "Die Cushions for Power Presses" known as catalog No. 4. It contains 151 9½ x 6½-in. pages, illustrated by means of photographs of the die cushions separately and also die cushions applied to the machines. Usually a cross-section is shown of each type of die cushion while a table gives the size ranges and capacities. Both single and multiple installations are shown. A considerable quantity of engineering data is appended.

GEARS. The Perkins Machine & Gear Co., Springfield, Mass. has published catalog No. 27 containing data sheets for the various types of gears which it

manufactures. Considerable space is given to the design and selection of gear drives of various types. The catalog is of a convenient size and contains 102 7x4-in. pages.

PNEUMATIC TOOLS. The Chicago Pneumatic Tool Co., Chicago, Ill. has issued catalog No. 561 describing its line of pneumatic tools and accessories. Each tool is illustrated by means of a photograph while a table presents the sizes and capacities. A great deal of material on the proper care of these tools is included. The catalog contains 70 11x8-in. pages and is pleasingly arranged.

PORTABLE COMPRESSORS. The Ingersoll-Rand Co., 11 Broadway, New York, N. Y. has published a 140-page book entitled "100 and 1 Ways to Save Money With Portable Compressors." By means of 300 photographs the widely varying uses of such machines are shown. Considerable cost data is presented for various types of work. The booklet is arranged in a very pleasing and instructive manner.

PUMPS, ROTARY. The Beach-Russ Co., 50 Church St. New York, N. Y., has issued Bulletin No. 36 describing several types of rotary pumps for various installations. The line includes high-duty vacuum pumps, single-stage high-vacuum pumps, gas boosters, liquid pumps, acid-resisting pumps, rotary condensers for oil burners, etc. The sizes and capacities of these pumps are given in tables, while special features of the construction are described. Each type is illustrated by means of a photograph.

VARIABLE SPEED TRANSMISSIONS. The Reeves Pulley Co., Columbus, Ind. has published catalog No. 88 describing the various speed transmissions of its manufacture. Parts 1 and 2 touch upon the construction and operating principles and also cover the design of remote controls and accessory parts. Automatic control is discussed in part 3. Parts 4 and 5 show the industries that use this transmission while part 6 contains engineering information. The catalog is gotten up in a pleasing manner and is profusely illustrated by means of photographs. Dimension diagrams of each type are included, together with an efficiency chart. The catalog contains 64 7x8-in. pages.

WRENCHES AND HAMMERS. The Husky Wrench Co., Milwaukee, Wis., has brought out a condensed catalog, No. 28, showing its line of interchangeable socket wrenches and soft-tip hammers. The socket wrenches are made in a wide range of sizes and styles for automobile repair work and general machine shop use. Several types of wrench handles are also shown. The soft-tip hammers have several interesting features and come equipped with either copper, composition or rubber tips. Many illustrations showing the uses of these tools are included.

Pamphlets Received

ACCURACY OF COMMERCIAL SCREW THREADS. The Department of Scientific and Industrial Research, London, England, has authorized the publication of a pamphlet known as "The Accuracy of Commercial Screw Threads," by F. H. Rolt and W. G. Ridge. This special report No. 4 considers the viewpoints of users toward the accuracy desirable for threaded parts, the suitability of the existing British Engineering Standards Association tolerances, and correlates actual measurements of samples with the opinions cited. The report contains 29 pages, 10 tables and 13 diagrams. Copies may be obtained for 1s. 3d. net from H. M. Stationery Office, Adastral House, Kingsway, W. C. 2, London.

ALLOY FORMULAS. The Niagara Falls Smelting and Refining Corp., 2204-2214 Elmwood Ave., Buffalo, N. Y., has issued a booklet known as "1001 Alloy Formulas" by Ernest G. Jarvis, fellow, the American Institute of Chemists. This book is an alphabetic compilation of many different-type alloys and explains how they are to be compounded to produce good castings. Chapters on deoxiders for the various alloys have been added. Where information as to tenacity, elongation, hardness, etc., are available, it has been included. The booklet contains 64 7x4-in. pages with many tables.

COMMERCE DEPARTMENT'S SERVICES TO INDUSTRY. The Department of Commerce, Division of Domestic Commerce, has issued a 15-page booklet entitled "Practical Aids for Domestic Commerce" which describes its services to the industry and domestic trade of the United States. Among the points discussed are the regional market surveys; the studies of market areas, distribution costs, trade association activities, and regional commodity movements; analysis of industries, simplification of commercial practices; and the directories of market-research agencies and of industrial, commercial and technical agencies.

ENDURANCE OF RAIL STEEL. The Department of Commerce, Bureau of Standards, has issued Technologic Paper No. 363, entitled "Endurance, and Other Properties of Rail Steel." It is divided into two parts; Part 1 deals with the endurance properties of rail steel, and Part 2 with comparative tests of rail steel cast in standard and sink-head molds of the Gathmann type. In general, rails rolled from sink-head ingots had higher endurance limits than those from standard ingots. A method is suggested whereby it may be possible to determine if rail steels in service are subjected to stresses greater or less than their endurance limits. Copies are available for five cents.

ENERGY HYSTERESIS LOSSES. The Department of Commerce, Bureau of Standards, Washington, D. C., has issued a pamphlet entitled "Statical Hysteresis in Cycles of Equal Load Range," by G. H. Keulegan, assistant physicist. The bulletin, known as Technologic Paper No. 365, deals with an investigation made to ascertain the influence of extreme loads on the energy-hysteresis loss in the cycles of equal load range during flexure of an Armco ingot-iron bar. It is an extension of the work reported in paper No. 332. Copies are available from the U. S. Government Printing Office, Washington, D. C., for five cents.

Employees Invest Billion in Company Securities

Wage earners and other employees of corporations in the United States own, or are now making payments for the purchase of, considerably more than a billion dollars worth of securities of the companies by which they are employed, according to the results of an investigation made by the National Industrial Conference Board. Many more millions have been invested by employees in companies other than those for which they work, aside from their indirect investments through savings bank deposits and life insurance. The billion dollars worth of stock purchased by employees in the employing companies, which is the present market value of their investment, is distributed among some 800,000 employees, an average of about $1,250 per employee stockholder.

While these figures are significant as showing the extent of the development of employee stock ownership during recent years and, to a degree, the growing diffusion of the ownership of securities, the chief significance of stock purchasing by employees as indicated by the report is its value as a factor in promoting the habit of saving and thrift among employees. This the board finds has been more important even than the direct influence stock ownership may exert on the employee's interest in the company's affairs and his relations toward the employing company. The board finds little evidence of employee stock ownership being a potential factor in furthering the so-called "democratization of industry," but emphasizes employee stock purchase plans as a valuable means of helping wage earners to provide against old age by aiding them to acquire an independent source of income during the active years of their earning capacity.

NEWS OF THE WEEK

A. F. Cooke Elected President of Gear Association

Delegates and guests visit Gleason Works

AT a well-attended, enthusiastic meeting of the American Gear Manufacturers Association, held in Rochester, April 19-21, A. F. Cooke was elected president. Mr. Cooke is first vice-president of Gears & Forgings, Inc., in charge of the Pittsburgh division. The meeting was the twelfth annual meeting of the society and was attended by more than 100 members and guests. B. F. Waterman, of the Brown & Sharpe Manufacturing Co., was elected first vice-president and E. W. Miller, of the Fellows Gear Shaper Co., second vice-president. The new treasurer is Warren G. Jones, of the W. A. Jones Foundry & Machine Co. T. W. Owen of 3608 Euclid Ave., Cleveland, Ohio, continues as secretary.

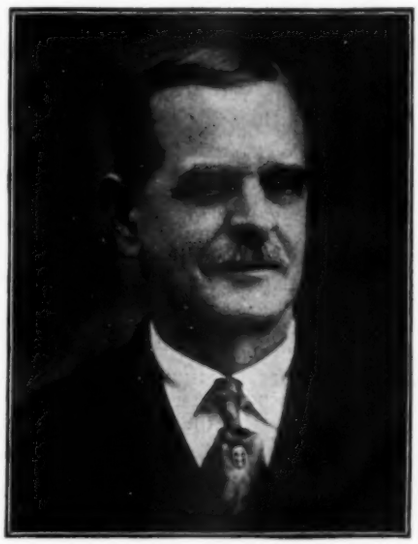
The following men were elected to the executive committee for a period of three years: E. W. Miller, of the Fellows Gear Shaper Co.; E. J. Frost, of the Frost Gear and Forge Co.; F. B. Drake, of the Johnson Gear Co.; and P. L. Tenney, of the Muncie Products Division of the General Motors Co. Warren G. Jones was elected to fill the unexpired term of F. W. Sinram. E. F. Davis and Harold C. Thompson were elected associate members from the Warner Gear Company.

Gleason Works Inspected

An afternoon was devoted to inspection of the plant of the Gleason Works where the members of the association were the guests of the Gleason company at luncheon. Of particular interest was the development work going on at the Gleason plant, although the plant itself, because of its arrangement, equipment and management, was an attraction of great magnitude.

Members were very much gratified at the return of George L. Markland, chairman of the board of the Philadelphia Gear Works and past president of the association. Mr. Markland had been seriously ill and on that account forced to suspend participation in the activities of the association. He was accorded a sincere and cordial welcome.

Technical papers presented at the several sessions were particularly strong and dealt with subjects of vital interest to the members of the association. "Gear Lubrication," by G. A. Round, assistant chief engineer of the Vacuum Oil Co., dealt with the design of transmissions and differentials of automobiles. "Non-Metallic Materials—What Part Will They Play in the Future of the Industry?" was the title of a paper by T. C. Roantree of the Westinghouse Electric & Manufacturing Co. Dr. C. E. Skinner, assistant director of engineering of the Westinghouse Electric & Manufacturing Co., presented a paper, "The Value of Research to the Present Day Manufacturer." "Contact of Standard Worm Gears" was the title



A. F. Cooke
New President American Gear Manufacturers Association

of a paper by J. C. O'Brien, of the Pittsburgh Gear & Machine Co. J. C. McQuiston, of the Westinghouse Electric & Manufacturing Co., who is also chairman of the publicity committee of the association, explained the advertising policy of his company, pointing out how the technical and business publications are used to reach industry and the newspapers are used to reach communities. He explained that this policy was adopted as a result of research on the part of his company and the business and technical press.

The reports of standardization and technical committees constituted a large part of the program. Outstanding among the results achieved during the past six months was the preparation of standards for future design for bevel gear nomenclature submitted by the nomenclature committee, of which D. T. Hamilton, of the Fellows Gear Shaper Co., is chairman. The nomenclature presented was adopted by the association as proposed suggested standards. Progress reports were made by the nomenclature committee, so far as nomenclature for herringbone gears is concerned; by the keyway committee, R. B. Zefrey, of the Tool Steel Gear and Pinion Co., chairman; by the spur gear committee, J. L. Williamson, of the Fellows Gear Shaper Co., chairman; by the sprocket committee, G. M. Bartlett, chairman; by the tooth form committee, H. J. Eberhardt, of the Newark Gear Cutting Machine Co., chairman; and by the non-metallic gear committee, T. C. Roantree, chairman. The metallurgical committee submitted for discussion a revision of the recommended practice for forged and rolled alloy steels.

In reporting for the research committee, Prof. Earle Buckingham, of Massachusetts Institute of Technology, stated that tests indicate that the strength of non-metallic gears is from 15 to 20 times the estimated safe loads according to present practice. The tests made use of 60-tooth non-metallic pinions running with 160-tooth steel gears.

Recommended Practices

B. F. Waterman, in reporting for the general standardization committee, of which he is chairman, mentioned by title the recommended practices that had been distributed to the membership since the last annual meeting. They included recommended practices for web holes for railway gears; standard keyways for holes in gears; external involute spur gear nomenclature; a revision of the rules for computing the horsepower of non-metallic spur gears composed of laminated phenolic materials or rawhide; a practice for industrial spur gearing back lash measured on standard center distance with feeler; tooth proportions of and disk gages for long and short addendum railway, helical and spur gears; a revision of practice for worm gears; a practice for forged and rolled carbon steel for gears; and a practice for bronze and brass casting for gears.

Dean Dexter S. Kimball, of Cornell University, was the speaker at the banquet. He explained the origin of some of the pecularities of decoration existing in industrial products, illustrating his remarks by lantern slides. As usual, his talk was very much to the point, containing much information and inspiration.

Andrew Gleason welcomed the delegates to the city of Rochester. Mr. Gleason was introduced by President Frost, who also made the annual presidential address. In part Mr. Frost said:

"We may well congratulate ourselves upon the fact that this annual meeting brings us to Rochester, the home of one of the great industries intimately connected with the gear makers' art.

"A short time ago there appeared in some house organ that chanced on my desk, a statement which will be appropriate to use as a sort of text or key-thought for my short message to you this time. It read like this:

When a business firm attempts to mold its whole policy to meet the prices of its competitor, that business is entering a labyrinth, the center of which is the chamber of despair. Highest quality never can be given nor obtained at the lowest prices. If a price can be sacrificed, quality must be sacrificed. If quality is sacrificed, society is not truly served.

"While this is true, it is equally true that progress is going on all about us and we must, if we are to continue in business, at least try to fit into the picture as it is, though this may differ radically from what we would like to have.

"After we have been in business for a number of years, I fear that we lose our pep so that we are content to try to whittle along with more or less antiquated equipment and growl immeasurably at the fellow who provides himself with up-to-date machinery and tools, and who is as a logical consequence, able to make more attractive prices and still have a satisfactory profit; perhaps even a greater profit than the man with higher prices and less adequate facilities.

"It is well for us to bear in mind as an industry organization, and as individual members of this association, the responsibility that must be ours in this, the most wonderful age of progress and material achievement the world has ever seen. We must bear our share in the general program of reduction of costs to the consumer, so long as such reductions can be legitimate and be done through increased efficiency of men, methods and machines.

"Quality must not be sacrificed for quantity, but a larger product must be obtained through better education of our producers, through elimination of wastes that are common in nearly all shops, through creating an active interest on the part of the workmen that will make each man feel that he is not a mere routine worker, but that he is a definite unit in a co-ordinated whole; and too, the office should bear its share of the program by buying satisfactory materials at right prices, by seeing that materials are in the shop on time, that jobs are started in their proper sequence and by giving the maximum of care to the selection of the most efficient machine tools and small tools, furnaces and other equipment.

"Good will and peace of mind amongst workmen are wonderful assets in any manufacturing plant, and these things have to be cultivated if not actually earned by the management through relationships that are founded on mutual understanding and a working adaptation of the Golden Rule.

"It has been recently estimated by an expert of the Department of Commerce that $30,000,000,000 is wasted annually in this country in industry, and that a large part of this loss could be prevented by intelligent use of competent laboratories.

"Instead of eternally harping about prices, let us see if preventing, or at least salvaging, some of this enormous waste will not only change loss into profit, but add unexpected zest to our jobs, if for no other reason than because of the novelty of the undertaking."

Round on Lubrication

Mr. Round, while admitting that lubrication engineers still have many problems to solve, pointed out that protection for working surfaces by means of lubricants is relatively easy and that most wear on gears and in bearings results from misalignment and from foreign particles that act as abrasives. He said that a serious problem in the lubrication of transmission and differentials is leakage due largely to increase in volume that results from foaming. This fault can be corrected by proper designing. Foaming is common in transmission housings but not pronounced in differentials. He explained that mineral oils have a tendency to oxidize with the result of approach toward a tar residue and that many greases tend to separate into their constitutent parts. One of the sources of abrasive particles is the gears themselves, the particles being freed by clashing. It was emphasized by Mr. Round that all transmission and differential cases should be arranged for draining.

Roantree on Non-Metallic Gears

Mr. Roantree, in his paper on non-metallic materials, limited his remarks to fabric products which he divided into two classes, those with which it is necessary to use shrouds and those composed of layers of fabric previously treated with a chemical bond which is molded, pressed and heated, such materials now being called laminated phenolic products.

In substance, Mr. Roantree said that shrouded gears rely upon the retaining properties of metal side plates, or shrouds, to give the necessary load carrying capacities. The non-shrouded type depend entirely upon the layers of fabric.

Today, the early limitations for gears made from this material have been so far removed that non-metallic material is in successful applications of gearing not only with spur teeth but on bevel, worm and herringbone gears, including those having the Sykes tooth form.

Non-metallic gears bring about reduction in vibration. The effect of such reduction on the life of any apparatus is naturally very great. Non-metallic gears are used in speedometers, cash registers, adding machines, phonographs and such types of apparatus where it is essential for accurate functioning with as little vibration as possible.

The importance and effect of the factor of resilience were of such moment that it was found advisable to change the velocity factor in the Lewis formula. The Barth equation was changed from $\frac{600}{600+V}$ to $\frac{150}{200+V}+0.25$. Several industrial applications requiring pitch line velocities of from 7,000 to 14,000 ft. per min. are giving very satisfactory results.

It is advisable whenever possible to make non-metallic gears from a single thickness of metal to avoid riveting, misalignment and unequal wear on the teeth as well as to reduce the cost of manufacture.

Dr. Skinner on Research

Dr. Skinner, in his paper "The Value of Research to the Present-Day Manufacturer," said, in part:

"Recent surveys indicate that the notable advances in industry as a result of research now come mainly from the established and well organized industrial research laboratories. Years ago, an inventor started on a fantastical search for a method of producing diamonds artificially. He failed to make diamonds, but succeeded in making a material which proved to be valuable as an abrasive. From beginnings of the manufacture of this material by ounces, has grown the vast business of manufacturing carborundum. Grinding with carborundum wheels has replaced tool machinery in many instances, giving both a better and cheaper product. Industries, such as the automotive and many others would be tremendously hampered if carborundum were taken away from us. This is well illustrated by the fact that in a simplification survey of grinding wheels by the Department of Commerce, over 750,000 types and sizes were found.

The introduction of new and improved materials not infrequently requires a more or less complete revision of the processes and machinery involved in the making of the product. The introduction of alloy steels, for example, both as materials of construction and in the form of tools, has completely revolutionized the process of heat-treatment in the production of many steel parts. There was a time when the tool dresser, for example, accustomed to carbon steels only, held his position very largely by his skill in judging by eye the temperature and conditions of hardening and drawing the temperature of the tools. The introduction of alloy steels of many varieties has made it desirable, in fact essential that heat-treatment be done on a strictly scientific basis and the use of the pyrometer and accurately controlled electric furnaces are not regular tools in many manufacturing plants.

The introduction of synthetic resins, such as bakelite, has revolutionized the processes of manufacture of many of the materials and products where such materials are applicable.

French Metal-Working Industry Looks to Renewed Activity

Campaign for greater consumption of metal inaugurated

By Our Paris Correspondent

IN SPITE of the approach of the French elections industry appears to be hopeful of a normal activity in the weeks to come. Actually, German payments in kind are handicapping a greater output in many correlated metal lines than might otherwise be the case. A general rise in the price of the raw material of the metal transforming industries is also affecting a greater production and distribution movement, as are high transport charges. The solution for big capacity plants would be to increase their home market, if possible, but to achieve this a price drop is called for though this will be difficult if, in the near future, the franc is stabilized at twenty-five to the dollar. Production costs could be lowered with a greater output which implies a greater consumption either at home or abroad, or both, but the home market is not greatly absorbent beyond the present state at ruling prices.

The electrical machinery industry, since 1913, has developed its capital from 300 million francs, producing 60,000 metric tons, valued at 200 million francs, to 4 billion francs production value based on a capital investment of 2.5 billion francs.

Exports of electrical machinery and electrical goods in general reached 630 million francs last year as against 34 million francs in 1913. The excess of exports over imports was valued at but 50 million francs in 1913, but has already increased to 390 million francs. The prosperity of the industry is more apparent than real, however, as the imported ton was valued at 4,000 francs gold in 1913, 5,105 francs gold in 1921, and 6,852 francs gold in 1926. At the same time the export ton decreased in value from 6,537 francs gold in 1921 to 4,034 francs gold in 1926. Imports were high-priced goods; exports were low-priced. There are six big plants turning out electrical traction and rolling stock and innumerable small plants scattered throughout the country devoting themselves to small electrical production; hence a general economic depression exists throughout the industry.

Metal Consumption Campaign

The Union des Industries Metallurgiques is campaigning for a greater consumption of metal in France. It urges the substitution of steel wheels for those of wood by farmers, metal construction for hangars, silos and the like. Railways are to be advised to use only all metal passenger and freight cars. Today but 10 per cent of such material is all-metal, the Union claims.

The same argument is applied to automobiles, where (in France) the latest and most popular novelty is an oilcloth or pegamoid covered body, which flaps in the wind. Steel, and other metals, are urged for shop fittings and furniture, likewise for building construction, and for home and hospital fittings. Undoubtedly a growing market exists for all this in France, but in many of its transformed shapes metal will call for new, rapid and efficient machinery which will have to be developed or acquired in order to bring production costs down to the desired level to command business. Machinery makers might do well to study the possibilities of such a market for machinery and tools.

The annual Lyons fair has just closed. The number of exhibitors was 3,382, which was 141 more than last year. The largest number of foreign exhibitors were from Switzerland, Great Britain and Germany, apart from a few direct American exhibits and many more shown by French importers of American tools and machinery.

The question may be asked as to how advisable it might be at the present time for American manufacturers to think of establishing plants in France. A few big units have made notable successes: others have confided their patents and their processes to some French manufacturer whose production facilities were not up to capacity. For the purely American-owned plant in France, or in association with French capital, there is the question of taxation on turnover and profits which it was claimed by a speaker at the American club in Paris recently as being more formidable on the whole than any actual or projected tariff increase. The counterweight more than balances the load except in rare instances where really big production may be achieved.

Price War Looms

The above facts are likely to be demonstrated by the looming price war between imported and French-made automobiles, agricultural machinery and various other utility units from metal-working tools to hoisting and road-making machinery and the like.

The French plan for a quota, or contingent quantity, to be applied to the annual import of automobiles from America, as rumor put it a week ago, is believed by those in the know as being impossible of achievement. If an accord was made to allow the import of Italian automobiles into France without limit, inflicting at the same time an import restriction to those from America, there would result a contravening of American rights that could only be answered by a similar restriction on some class, or classes, of French goods sent to America. America might stand the pressure; it is unlikely that France could.

France again would be going directly against the tariff recommendations of the League of Nations, in which French delegates took so large a part. The League plan is to abolish all import and export restrictions or contingents, leaving the matter of customs dues *per se* apart. An American automobile representative suggested that the way for France to improve her automobile manufacturing situation was to form a combine among her makers to enable them to sell their product at a price that would compete with that of American cars. The new Ford car as shown in France, in spite of its price (with the nearly 60 per cent *ad valorem* added), is, for what is offered, cheaper than any competing French car. As André Citröen said, "taxation to the sky is one of the reasons why even mass production in France can not be brought down to the American price level." He might have added that mass production would not bulk as largely either.

Effect of Tariff Revision

The tariff revision of March 19 has brought some modifications that affect American exports. Electrical generators pay from 36 centimes to 1.46 francs the kilogram, according to weight. Aluminum products are taxed at 1.83 francs the kilo and screws, bolts, screw-eyes, rivets and nuts of a diameter of less than 3 mm. pay 109.44 francs the hundred kilos. All the above are subject to the application of the coefficient, which fluctuates from time to time. In spite of the fact that ball and roller bearings are being turned out here in annually increasing volume, imports from abroad still continue on a large scale. America's export to France still benefits from the minimum tariff scale.

Bolts and nuts are not greatly in increased demand, as was anticipated few weeks ago. The consortium of makers seems unable to decide on a general policy or price scale. The complaint is that there are too many small producers.

Stampings and forgings for the automobile industry have slowed down in demand pending the arrival of the boom in buying which has been slow in materializing. Most makers are delivering from stock, reversing the old policy of keeping the customer on a waiting list while his product was manufactured for him. Railways are also making but few calls for like products.

Construction steel and iron is less in demand, due to the slowing down of building operations which itself is also, it is claimed, a result of inordinate taxation. Railways have been buying some motive power and rolling stock units, but nothing on a very great scale.

It is interesting to note that the Fichet company, the largest and best known maker of safes and bank vaults in France, has acquired the rights to the Parker process for treating iron and steel in their line.

Small tools and machines show a revival which French makers find encouraging after the dullness of the past months, although prices are not showing any tendency toward a rise. Woodworking tools are feeling the competition from German product. France, how-

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The Business Barometer

The outlook in Commerce, Finance, Agriculture and Industry

By THEODORE H. PRICE

Editor, Commerce and Finance, New York

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LAST week the New York *Sun* published a description of the Wall Street boom in which it was estimated that about 10,000,000 persons, including 500,000 women, are now buying and selling stocks. The crowds that are to be seen in brokers' offices, even in the smaller cities, and the huge business that is being handled on the stock exchanges, the curb exchanges, and the "over the counter" markets, indicate that an enormous public is now speculating. But whether it be five or ten millions, does not make much difference. Either figure connotes a crowd so large that it is practically uncontrollable as long as its resources last and its enthusiasm is not chilled.

Conservative stock brokers are doing their best to meet the situation by asking for margins hitherto regarded as prohibitive, the money market is distinctly firmer, gold continues to go out in large quantities, the Federal Reserve banks at Boston and Chicago have raised their rates to 4½ per cent, and the other banks are expected to follow shortly as their open market operations indicate that they are selling securities, and the total of brokers' loans in the New York district shows an increase of $135,000,000 for the week. But the only effect was a temporary reaction in some speculative favorites whose decline was almost offset by an advance in the hitherto neglected oil group.

Meanwhile the Stock Exchange was closed on Saturday so that the brokers' clerks might catch up with their work, and it remains to be seen whether Friday's hesitancy was the beginning of the end, or simply a halt to get breath for a further ascent. The precedents all indicate that it would be difficult to check a movement that has acquired such impetus, but we are told that precedents are no longer applicable and that the Federal Reserve Banks can be relied upon to control the situation when control becomes necessary.

It is to be hoped this is true. Meantime it is worth noting that bank stocks and even industrial common stocks are now selling at prices which yield less than can be obtained from first class bonds. This may be all right in the new financial era that is so widely acclaimed, but many old fashioned folk, who would rather be safe than sorry, are gradually exchanging their stocks for bonds.

But to merchants the important question is, will the flood of Stock Exchange inflation inundate the commodity markets? To this question the future must supply the final answer, but there is much in last week's record to suggest that it may be affirmative. While corn, wheat, and oats for example have all touched "new heights," sugar has been surprisingly firm, coffee has held up its head again; rubber has stopped declining, and May cotton has sold at over 20 cents, despite an improvement in the crop outlook and the strikes in New Bedford and Bombay.

In each case the strength is attributed to some technical development, but the truth is that no one dares to be short of anything, and the resulting scarcity of sellers makes it easy to bid up prices.

But the situation thus created would of course become highly dangerous if anything happened to change sentiment, and it is for the first real sign of such a change that those who are careful will watch.

Up to the present there is but little to indicate that the advance in securities has enlarged distributive trade, or increased the purchasing power of the masses. Car loadings continue to run about 4 per cent under last year, and the textile industry is still complaining of over-production. Hence the reduction in wages which has provoked the strikes at New Bedford, and the short time that is being resorted to in some Southern mills. "A pause in the demand" for steel is also noted by the normally optimistic trade papers, while other authorities admit that the "price situation is undeniably weaker."

In confidence some automobile dealers will concede that the market is blocked with used cars, although it is easier to sell expensive equipages to stock brokers and their clients. Pearls and diamonds are also in better demand and even fur coats are readily salable despite the approach of summer. This is not surprising for those whom fortune has favored in the stock market are generally free spenders and the purveyors of costly luxuries are looking forward to a period of prosperity.

But it will take time to distribute the huge speculative profits that have been made and their effect upon trade in general will not be felt, for at least a month. In that period much can happen and for conservative merchants a policy of opportunism would seem to be wisest.

In Europe there appears to be a continuous improvement in economic conditions. The flood of gold that we are releasing, plus the South African production, is irrigating the field of credit, and the result is prosperity. One effect has been an increase in our exports and imports during the month of March. The net balance in our favor is not much changed but we have bought more and sold more. This is really the most encouraging item in the week's news and we can contemplate it with satisfaction while we wait for events to determine whether we are in a new and millennial era of finance from which declining markets have been banished, or simply the deluded victims of our own enthusiasm.

WHAT'S DOING IN INDUSTRY

A SLIGHT lull in machine tool buying is noted in several sections of the country in the past week, although in some centers buying continues to improve or hold its own at a high level. In Cincinnati a slight timidity in placing orders is evident, but plenty of business is in the air awaiting closure, and inquiries are plentiful. In Cleveland also machine tool trade is quiet and somewhat spotty. In some instances there has been a slight decline in orders, and, as in the case of Cincinnati, a slight resistance to buying is noted with many orders pending. There has been an actual increase in inquiries, however.

PHILADELPHIA also presents a spotty market, the most active shops being those of gear manufacturers. In Chicago, April business has not measured up to that of March thus far, except for one or two companies, but as in other centers, inquiries are in good volume and future activity is expected.

MACHINE tool builders and allied manufacturers in the Buffalo district are all busy, and some report an exceptional quarter. The surrounding region has not been a good market, however, for some months. New England builders are also busy, and metal-working shops in that section are all well occupied. Reports of activity in such shops in other parts of the country continue to come in, indicating that they are all well employed. In fact, figures on employment from various centers, such as Detroit and Milwaukee, where the automotive influence is felt, all indicate steady increases in the past two months.

The Industrial Review

Weekly progress of the machinery and machine tool business

THE following reports, gathered from the various machinery and machine tool centers of the country, indicate the trend of business in these industries and what may be expected from the future:

MILWAUKEE

The demand for metal working equipment is moderately active and most plants manufacturing tools are able to maintain operations at a relatively satisfactory rate. The situation has its spotty characteristics, but these are expected under prevailing conditions. While some plants report a slight improvement in the volume of new orders, others have been experiencing a slight falling off, giving an average business for April that is probably at least equal to the March volume.

A favorable development is the continuance of improvement in the local employment situation. During March, 2,637 persons were placed in positions, as against 1,772 in February. Officials comment attributes this increased demand to the requirements of metal trades shops and building construction. Shops manufacturing automobile units, parts, and accessories are perhaps busier than most others, and furnish a correspondingly good market for tools. The effort generally is not so much to gain substantially in new capacity, but to keep present capacity at its most efficient point, and this accounts for a replacement demand that is the main support of the tool market at this time. The call for special tooling is also brisk.

Current inquiry is of a nature that makes probable a continuation of business along this line for several months to come.

DETROIT

The general condition of the machinery and machine tool trade in Detroit is not only keeping up with the record of prosperity set in March but is rapidly going beyond. There is a general balancing up throughout the trade. Motor car manufacturers are buying steadily and consistently, inquiries are coming in regularly, and there is a fordward-looking tone. Even the small shops are coming in for good sized orders, indicating that the automotive industry is at a peak.

The Ford Motor Company has given out many contracts for work to the small shops. Efforts are being made to bring up production, and it is stated that the company has now reached 2,000 cars a day.

Chevrolet is breaking all production records, Pontiac and Oakland are going forward rapidly as are also Dodge, Graham-Paige, Willys-Overland, Oldsmobile, Studebaker, Kelsey Wheel, Budd Wheel, Motor Products and others.

CHICAGO

Thus far in April business in machine tools has not, on the whole, been maintained on an equal level with that for the same period in March. There are exceptions, however, as some concerns report the first two weeks of the present month as having developed more business than during any similar period of this year. In the main, demand is good, and inquiries are multiplying.

No further buying, with the exception of an occasional heavy-duty tool, is reported as having been done by railroad interests, nor have any new lists been forthcoming from this source. The International Harvester Co. continues to be an important factor in the market, and tractor plants are steadily adding to their shop equipment. The automotive and auto accessory industries are reported as furnishing a good volume of present business, but general industry is depended upon, especially by those dealing in used tools, for the bulk of trade. There appears to be no immediate prospect of new developments in a business direction, but dealers and manufacturers' representatives express themselves as having no complaint to make with respect to present market conditions.

NEW ENGLAND

Comfortable order balances keep most machine tool builders in the New England area well occupied. Working schedules, as a whole, are well maintained; and the current week indicates the industry to be doing better than holding its own. Orders during the week were for one or two tools with no outstanding lists in the orders placed or among the inquiries. Final items to close a list of 30 machines for the automotive industry, in evidence as inquiries for some time, were placed with Connecticut and Massachusetts builders.

Improvement in the metal-working industry has not produced a normal condition, but plants are doing well in maintaining gains made since the first of the year. Construction programs in this section are most encouraging and include a large industrial expansion. The Boston & Maine Railroad is to build an electric four-track coaling plant at East Deerfield, Mass., which calls for mechanical handling equipment.

Used machine tools are plentiful, and are offered at very low figures without attracting consistant buying. According to reports from leading dealers the market is uncertain and spotty, but the total volume of sales is fairly substantial.

CLEVELAND

Business in the local machine tool trade during the first half of April was quiet and spotty. Although slight increases in sales are reported by one or two dealers, the producers report declines in actual orders closed compared with the previous month. A good many orders are pending but stronger resistance in buying is noted. Orders closed were chiefly for one and two pieces.

The automobile industry has been a constant buyer in the Cleveland market and with an increase in production of cars in sight, considerable more business is in prospect from this source. Rubber tire, boiler shops and pipe fitting manufacturers made recent purchases. The Spicer Manufacturing Co., Toledo, are buying a list of tools.

The most encouraging feature of the past week has been the increase in number of new inquiries. A few are of fair size and a pick up in business is expected in the near future.

CINCINNATI

Approximately one-third of the machine tool manufacturers in the Cincinnati district report a slight gain in sales in the past week, about the same number report a slight falling off of business, and an equal number report that they held their own. Taking the trade as a whole, and striking an average, it seems that the sales were slightly lower than in the previous week. The concensus is that this has only been a temporary lull, due to a sudden timidness which has caused orders to be held back, with a large amount of business pending.

A few scattering orders received in the week called for more than one tool, but the great majority called for single tools and replacements. The great majority of the sales were well diversified as to destination. There was a slightly increased amount of buying from concerns in the automotive industry, but no large lists were placed.

The greater portion of the manufacturers report that inquiries came in freely during the past week, but for a few there was a slight falling off. The inquirers were all well scattered over the country, the major portion of them being general machinists and miscellaneous users.

PHILADELPHIA

A spotty condition has prevailed in the machinery and machine tool market in Philadelphia during the last two weeks. In some lines the spring business has not been up to expectations and inquiries either fell off during the period or were entirely lacking. Gear manufacturers reported some orders and a busy situation in their plants, but in other lines the feeling was reversed, particularly in metals and abrasives.

The bright spot in Philadelphia's machinery future just now is the purchase of shop equipment for the repair plant of the new Broad St. subway, the contracts for which are to be awarded within a few weeks. The entire plant is city-owned and will be leased to a private operating company.

Manufacturers and dealers regard the lull now as incidental and are unanimous in anticipating a brighter future.

BUFFALO

Figures now available indicate that the first quarter of 1928 in the machine tool trade in the Buffalo district produced as good business in almost every instance, and better in some, as did the first quarter of 1927. Dealers are entering the second quarter of the year with optimism. Two or three report exceptionally good business.

In the electrical equipment trade, with few exceptions, orders continue to be small, and conditions are not quite as good as in the machine tool trade. However, a fair volume of small orders is responsible for a fairly good gross.

While the real spring business of the contractors' supply group has not yet really opened up, conditions are much better than they were a month ago, and there are fairly certain indications of activity in the near future.

NEW YORK

Sales in machine tools and allied lines continue at a good level in the Metropolitan District. Most dealers handling diversified lines report that, although no outstanding orders have been placed, a steady volume of single items assure them of enough business in April to at least equal, if not top, that of March, which was a very good month. Direct factory representatives also report considerable activity in most instances. Most deliveries are scheduled for the near future, although in a few cases they are many months ahead.

Salesmen visiting metal-working shops in the vicinity report considerable activity on the whole. Shops making airplane engines, fuselages and parts are going strong, and are steady buyers of equipment. The Wright Aeronautical Corporation has been mentioned as a buyer for some time, and because of additional plant expansion, it is expected that this company will continue

as a good buyer for some months. One indication of general shop activity is the fact that small tools are selling well: drills, taps, chucks, grinding wheels, and vises are all finding a good market.

A few orders from railroads were placed in the past week: the N. Y. Central R.R. bought a 24-in. Aurora drill and two Ransom grinders; the Texas & Pacific R.R. bought a 53-in. tire mold mill; and the C. B. & Q. R.R., a 36-in. Niles-Acme shaper. Among other machines sold in New York for consignment to outside points were: a 12-in. vertical shaper (Mass.); a 1,500-lb. steam hammer, a No. 3 P. & W. die sinker, and two lathes to companies in Chicago; a 14-in. vertical surface grinder, a 4-spindle drum-type miller, and a 3-spindle drill to companies in Detroit; a jig borer to a tool company in Philadelphia; three surface grinders to a Toledo company; a die sinker to an Indiana forge company; a 5-ft. radial drill to a coal company; and several scattered orders for lathes.

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ever, still holds a considerable portion of the trade in boring tools in spite of well-known American makes which have long been on the market here. British makers have even penetrated to a greater extent than has been known previously. Much the same observation holds true of saws, files and abrasive machinery. Special tool steels are finding competition from the products of the Saar.

The French Westinghouse Co. has received an order for brake installation for French railways which aggregates a value of 202 million francs. Orders of a like value have been given German firms on reparations account on behalf of the French railways as well.

But 376 alien laborers passed the frontier labor bureaus for the mid-week of the month of March. Mines, quarries, heavy metallurgy and pick and shovel day laborers, were represented, but practically none in skilled trades. The government labor bureau gives but 13,000 as the number who have applied during the month for work.

S.A.E. Discusses Standardization of Aircraft

In connection with the Aircraft Show, the Society of Automotive Engineers held a meeting in Detroit on April 18 at which standardization of aircraft details was discussed at some length. The meeting followed visits to the Ford Airport, the Aircraft Show and the Packard plant. Assistant Secretary E. P. Warner of the Navy presided, pointing out that, while some contended that it was too early for standardization, it was much easier to agree on some standards when an industry was young than after various manufacturers had established different standards of their own.

The Army and Navy had already adopted many standards, known as the A-N standards, some of which are probably more rigid than is necessary for commercial and personal planes. The A-N standard requires high tensile bolts and there was considerable discussion as to the advisability of making these in two qualities so as to make it possible to get the low-grade bolt in a place where the alloy bolt was required.

Tail skids, wheels, rims, tires, engine mountings, instruments, engine fittings and storage batteries were reported on by various committee chairmen and discussed. The opinion was expressed that tail skids would probably be replaced in the near future by wheels with brakes. The tolerances permissible on axles with and without brakes and the use of ball or rollers instead of plain bearings, was discussed, it being felt that a tolerance of not more than 0.003 in. was permissible where brakes were used and double this without brakes.

Owing to the great diversity of engine design, especially in the smaller powers, a detachable engine mount was suggested, at least until the industry is more stabilized. In this way the front end of the fuselage can be made to take a standard engine mounting piece, the front end of this being built to suit the particular engine. Propellor shaft ends, both tapered and splined, are being considered so as to allow interchange of propellers with standard hubs.

Ford Reports $42,786,727 Cut in Surplus

The tremendous costs involved in the development of the new Ford car are reflected in a drop of $42,786,727 in the profit and loss surplus of the Ford Motor Car Company in 1927. The balance sheet as of December 31, 1927 showed that total assets dropped from $784,208,080 at the close of 1926 to $742,056,101 at the close of 1927, and that profit and loss surplus declined from $697,637,788 to $654,851,-101 during the same period.

Wills-St. Clair Equipment Sold

All the machinery and equipment in the Wills-St. Clair plant at Marysville, Mich., has been sold to the Manhattan Machinery Exchange, 30 Church St., New York. According to Theodore Friedeberg, president of the Exchange, the equipment is worth about $2,000,000 and 98 per cent of it is modern.

Machine Tool Dealers to Meet

Announcement has been made that the Associated Machine Tool Dealers will hold their annual spring meeting at Granville, Ohio, May 23 to 26, inclusive. E. P. Essley, of the E. L. Essley Machinery Co., 551 W. Washington Blvd., Chicago, is secretary of the group.

Lewis F. Lyne Dies

Lewis F. Lyne, a former member of the editorial staff of the *American Machinist*, died at Christ Hospital in Jersey City, March 16, at the age of eighty years. Born at Clinton, Conn., Mr. Lyne first worked in his father's harness shop and after engaging in other branches of industry, entered the Altoona Shops of the Pennsylvania R.R. as an apprentice. After a year's service with the Lake Shore R.R. at Cleveland, he came East and entered the employ of the D. L. & W. R.R. at Hoboken. In a short time he became assistant to the master mechanic and was charged with laying out and equipping the new shops at Kingsland, N. J., and was in charge of these shops for several years.

In 1878, Mr. Lyne was appointed mechanical engineer of the *American Machinist*, and soon became widely known through his plain, practical writings on engineering matters. During his association with the *American Machinist*, Mr. Lyne made many improvements in locomotives and stationary engines. He was one of the first, if not the first, to apply the indicator to locomotives. One noteworthy instance of this application was in indicating Locomotive 169 on the Central R.R. of New Jersey. This locomotive was the fastest one in America at that time, and indicator cards were taken at some remarkably high speeds.

Lewis F. Lyne

Mr. Lyne was one of two engineers who made the first test of the Edison system of incandescent lighting, erected at Menlo Park, N. J. After severing his connections with the *American Machinist*, Mr. Lyne became interested in the improvement of electrical machinery and was accredited with the adoption of mica as an insulator for commutators. After six years of experience in the electrical industry, he became consulting and constructing engineer for James Beggs & Co., New York.

At the beginning of the World War, Mr. Lyne enlisted in the U. S. Ordnance Department as Inspector and served in that capacity until the Armistice was signed. Upon leaving the Government service, he joined the engineering department of Colgate & Co. He was chief engineer of this company at the time of his death.

Business Items

The firm of H. W. Petrie Ltd., Toronto, Ont., has been appointed the Canadian agent of Alfred Herbert Ltd., makers of machine tools of Coventry, England.

The Brown Instrument Co. has secured larger quarters for its Pacific Coast branch at 420 S. San Pedro St., Los Angeles, Calif. Stanley F. Godfrey is manager.

The New York City sales office of the Wagner Electric Corporation has been moved to 30 Church St. The service station remains at 321 W. 54th Street.

The American headquarters of the Leipzig Trade Fair have been moved to the Salmon Tower Building, 11 W. 42nd St., New York, N. Y. The office maintains free commercial information service for American business men interested in the Fair or in trade with Germany.

The Columbus McKinnon Chain Co., Tonowanda, N. Y., has acquired control of the Hoist Division of the Chilsom-Moore Manufacturing Co., of Cleveland, Ohio. The general sales offices and the factory of the Chilsom-Moore company will continue to operate in Cleveland, and the personnel will remain the same.

W. R. Voores & Co., San Francisco, Calif., and Seattle, Wash., are now representing the Billings & Spencer Co., of Hartford, Conn., in Montana, Colorado, Utah, Wyoming, Idaho, Nevada, Washington, Oregon, California, New Mexico, and El Paso, Tex. They will handle the entire Billings line of small tools as well as special forgings and machinery.

The Gunite Corporation, Rockford, Ill., was recently incorporated to manufacture and market the product "Gunite," a gun-iron alloy previously made by the Gunite Division of the Rockford Malleable Iron Works. Duncan P. Forbes is president and John A. Forbes, secretary and treasurer of the new organization. Gunite is a wear-resisting cast metal for use in making machine parts.

The Veeder Manufacturing Co., Hartford, Conn., manufacturers of odometers, tachometers and other industrial counting machines, has been purchased by Paine, Webber & Co., of Boston and New York, investment brokers, for a price said to be in excess of $2,000,000. Directors of the Root Co., Bristol, Conn., have voted to sell to the Paine-Webber company, after which a merger of the Veeder and Root interests will be effected. The Root Co. also manufactures a line of counters.

The R. C. Neal Co., Inc., announces that it has increased the number of its directors from three to five. The directors now are: Ray C. Neal, president and treasurer; Paul R. Smith, vice-president; Clifford M. Sears, manager of the Rochester office, and secretary; Anders Sorenson, manager of the Syracuse office, and Miss A. McCarrick, assistant treasurer and secretary. The company, which markets production tools and wire products, is also adding two salesmen on May 1, Merrit T. Wilson and Frank S. McCoy.

The Lincoln Electric Co., of Cleveland, announces several additions to its sales and welder service divisions. H. A. Stamper has been placed in charge of consumer motor sales in the New York district, and D. F. Tjtus is in charge of welder service in the same district, both under G. N. Gull, district manager. A. H. Kirkpatrick replaces D. W. Carver as manager of welder service in the Cincinnati district, and H. E. Nelson has taken charge of consumer motor sales in this district. Mr. Carver has been transferred to the Cleveland district. P. A. Ludwig has assumed charge of welder service in Philadelphia and vicinity. Forrest Kessler has been transferred from the welding time study department at the factory to welder service division in the Cleveland district. J. R. Rothermel is in charge of welder service at Chicago, while W. Weaver has been placed in charge of consumer motor sales in the same territory.

Personals

MARK KIRSTEIN, representing the Snellex Manufacturing Co., of Rochester, N. Y., is out on the Pacific Coast establishing agencies for the ball- and roller-bearing lathe centers made by this company.

F. W. MCINTYRE, vice-president, and A. W. SCHNEIDER, works manager of the Reed-Prentice Corporation, Worcester, Mass., have been elected to the board of directors of that corporation.

WAYNE H. EDDY has been appointed chief inspector of the Oakland Motor Car Co., succeeding R. R. Todd, resigned. Mr. Eddy has been chief tool designer for the last two years.

WM. J. HENKEHOLD has succeeded H. S. Riggs as advertising manager of the Lodge & Shipley Machine Tool Co., Cincinnati, Ohio. Mr. Riggs has joined the Globe-Wernicke Co. in a similar capacity.

KENNETH GRANT, formerly of the Machinist's Supply Co., of Chicago, has joined the sales organization of Foote Bros. Gear & Machine Co. He will cover southern Wisconsin, northern Illinois, and eastern Iowa from the central office in Chicago.

EDWIN B. PEET, formerly connected with the E. W. Bliss Co., of Brooklyn, has again become associated with that company in its sales department. He will devote his time principally to can-making machinery and allied products.

W. E. GROENE, former advertising manager of the R. K. LeBlond Machine Tool Co., Cincinnati, Ohio, has become Eastern representative of that company. He is succeeded by W. H. Rybold as advertising manager.

MARCUS CHASE, manager of the Boston, Mass., office of the Niles-Bement-Pond Co., has resigned after 29 years of active service with that company. He is succeeded by M. S. Bradley, who has been his assistant for the past 15 years.

MARTIN A. O'MARA, former vice-president of the White Motor Co., has been elected president of the Brockway Motor Truck Corporation. George A. Brockway, founder and former president of the Brockway company, was elected chairman of the board.

WILLIAM S. GRAU has resigned his position as production superintendent of the Union Tool Co., Torrance, Calif., to take charge of the new plant of the Doheny Stone Drill Co., at Lomita, Calif., in the capacity of plant superintendent, effective January 1, 1928.

A. E. HALL, manager of the milling machinery department, Allis-Chalmers Manufacturing Co., Milwaukee, has been appointed a member of the National Committee on Wood Utilization of the Department of Commerce. Mr. Hall has had wide experience in the sawmill machinery field and will be assigned to special work along the lines of sawmill equipment. He will represent the American Society of Mechanical Engineers on the committee.

A. CECIL THARIN, Jacksonville, Fla., and Pat E. Sineath, Jacksonville, have formed the firm of Tharin & Sineath in that city for the distribution in Florida and part of the Southeastern district of machinery, mill supplies and similar equipment. Mr. Tharin formerly was with Cameron & Barkley, Jacksonville, as a salesman, while Mr. Sineath was for some years secretary of the Reynolds Machinery Co., Inc., also of Jacksonville. The new firm represents the Glauber Brass Manufacturing Co., and several other companies.

Obituaries

JAMES J. WOOD, of Fort Wayne, Ind., engineer and inventor, holder of 240 patents for electrical and mechanical devices, died at Asheville, N. C., where he had gone to recuperate from a long illness. His age was 72. For more than forty years he was associated as an inventor and consulting engineer with the Thomson-Houston and General Electric companies. He was concerned in the manufacture of the Brayton oil engine installed in the first Holland submarine, and he built the machines for constructing the main cables used on the original Brooklyn Bridge.

ELIAS ELKAN RIES, who discovered the underlying electrical principle which made possible electrified railroads, died of pneumonia at his home in New York. Mr. Ries was prominently identified with the advance of the electric light industry. He is credited with the invention of the first practical self-starting electric motor and original methods in electric welding. During his lifetime Mr. Ries took out more than 200 patents. His patents on his inventions in electrical railroading were credited to him after nearly fourteen years of litigation and were purchased by the Westinghouse Electric and Manufacturing Co. in 1903.

Forthcoming Meetings

American Society of Mechanical Engineers. Spring Meeting, May 14-16, Pittsburgh, Pa. Calvin W. Rice, secretary, 39 West 39th St., New York City.

American Foundrymen's Association. Convention and Exhibit, Philadelphia, May 14 to 18. Technical Sessions at Hotel Belleview-Stratford; exhibit at Commercial Museum. R. E. Kennedy, secretary, 140 So. Dearborn St., Chicago.

Gray Iron Institute. Open meeting, May 18, Philadelphia Commercial Museum. D. M. Avey, temporary secretary, 1213 W. Third St., Cleveland, Ohio.

Southern Supply & Machinery Dealers' Association. Will meet in annual convention in Nashville, Tenn., May 15, 16 and 17 jointly with the **National Supply & Distributors' Association** and the **American Supply & Machinery Manufacturers' Association.**

Associated Machine Tool Dealers. Annual spring meeting, May 23 to 26, at Granville, Ohio. E. P. Essley, secretary, 551 W. Washington Blvd., Chicago.

National Association of Purchasing Agents. Annual meeting and "Informashow," Kansas City, Mo., May 28 to 31. W. L. Chandler, secretary, 11 Park Place, New York.

American Railway Association. Schedule of sectional meetings: Division V, Mechanical, June 13 to 20, Atlantic City, N. J.; Division VI, Purchases and Stores, June 13 to 15, Atlantic City, N. J. Division VII, Electrical, Sept. 22 to 28, Cleveland, Ohio. J. W. Welsh, secretary, 292 Madison Avenue, New York City.

Association of Iron and Steel Electrical Engineers. Annual meeting, Stevens Hotel, Chicago, June 25 to 29. J. F. Kelly, managing director, Empire Bldg., Pittsburgh, Pa.

American Society for Testing Materials. Annual meeting, Chalfonte-Haddon Hall, Atlantic City, N. J., June 25 to 29. C. L. Warwick, secretary, 1315 Spruce St., Philadelphia, Pa.

Society of Automotive Engineers. 1928 Summer Meeting, Chateau Frontenac, Quebec, Canada, June 26 to 29. C. E. Heywood, in charge of meetings, 29 West 39th St., New York.

American Railway Tool Foremen's Association. Annual meeting, Hotel Sherman, Chicago, Sept. 12, 13 and 14. G. G. Macina, secretary, 11402 Calumet Ave., Chicago.

American Railway Tool Foreman's Association. Sixteenth annual convention of the Supply Association, Hotel Sherman, Chicago, Sept. 12, 13 and 14. F. A. Armstrong, secretary, the Pratt & Whitney Co., 564 W. Monroe St., Chicago.

National Safety Council. Seventeenth annual safety congress will be held in New York, October 1-5. Idabelle Stevenson, executive secretary, 1 Park Ave., New York.

American Society for Steel Treating. "National Metals Exposition," Commercial Museum, Philadelphia, Pa., week of Oct. 8. W. H. Eisenman, secretary, 4600 Prospect Ave., Cleveland, Ohio.

The Weekly Price Guide

Rise and Fall of the Market

PIG-IRON buying continues in small lots with prices unchanged. March structural steel sales totaled 202,251 tons, a gain of 6 per cent over the same month last year. Cutting under the official quotation of $1.90 per 100 lb., Pittsburgh, for bars, shapes and plates is reported to the extent of 5c. per 100 lb. on carload or larger lots. Furnace coke at Connellsville is $2.60 @$2.75 per ton, against $2.65@$3.00 last week; foundry grades remain unchanged.

(All prices as of April 20)

IRON AND STEEL

PIG IRON—Per gross ton, f.o.b.:

CINCINNATI	
No. 2 Southern	$21.44
Northern Basic	20.89
Southern Ohio No. 2	21.19
NEW YORK—Tidewater Delivery	
Southern No. 2 (silicon 2.25@2.75)	25.62
BIRMINGHAM	
No. 2 Foundry	16.00
PHILADELPHIA	
Eastern Pa., No. 2x (silicon 2.25@2.75)	21.76
Virginia No. 2	27.17
Basic	21.26
CHICAGO	
No. 2 Foundry local (silicon 1.75@2.25)	20.00
No. 2 Foundry, Southern (silicon 2.25@2.75)	22.80
PITTSBURGH, including freight charge ($1.76) from Valley	
No. 2 Foundry	20.26
Basic	19.26
Bessemer	21.26

IRON MACHINERY CASTINGS—Cost in cents per lb. of 100 flywheels, 6-in. face x 24-in. dia., hub not cored, good quality gray iron, weight 275 lb.:

Detroit	4.50@4.75
Cleveland	5.00
Cincinnati	4.30
New York	5.25
Chicago	4.50@4.75

SHEETS—Quotations are in cents per pound in various cities from warehouse; also the mill base in large lots.

Blue Annealed	Pittsburgh Mill Base	Chicago	Cleveland	New York
No. 10	2.10@2.20	3.50	3.25	3.90*
No. 12	2.15@2.25	3.55	3.30	3.95*
No. 14	2.20@2.30	3.60	3.35	4.00*
No. 16	2.30@2.40	3.70	3.45	4.10*
Black				
Nos. 18 to 20	2.60@2.70	3.75	3.55	4.00
No. 22	2.75@2.85	3.90	3.70	4.15
No. 24	2.80@2.90	3.95	3.75	4.20
No. 26	2.90@3.00	4.05	3.85	4.30
No. 28	3.05@3.15	4.20	4.00	4.45
Galvanized				
No. 10	2.95@3.05	4.10	3.90	4.25
Nos. 12 to 14	3.05@3.15	4.20	4.00	4.35
No. 16	3.15@3.25	4.30	4.10	4.45
No. 18	3.30@3.40	4.45	4.25	4.60
No. 20	3.45@3.55	4.60	4.45	4.75
No. 22	3.50@3.60	4.65	4.50	4.80
No. 24	3.65@3.75	4.80	4.60	4.95
No. 26	3.90@4.00	5.05	4.85	5.20
No. 28	4.15@4.25	5.30	5.10	5.45

*250 to 3,999 lb.; 249 lb. and under plus extra of 50c. per net order.

WELDED STEEL PIPE—Warehouse discounts are as follows:

	New York Black	New York Galv.	Cleveland Black	Cleveland Galv.	Chicago Black	Chicago Galv.
1 to 3 in. steel butt welded	53%	39%	55½%	43½%	54%	41%
2½ to 6 in. steel lap welded	48%	35%	53½%	40½%	51%	38%

WROUGHT STEEL PIPE LIST

Size, Inches	List Price per Foot	—Diameter in Inches— External	Internal	Thickness Inches
1	$0.17	1.315	1.049	.133
1¼	.23	1.66	1.38	.14
1½	.27½	1.9	1.61	.145
2	.37	2.375	2.067	.154
2½	.58½	2.875	2.469	.203
3	.76½	3.5	3.068	.216
3½	.92	4.0	3.548	.226
4	1.09	4.5	4.026	.237
4½	1.27	5.0	4.506	.247
5	1.48	5.563	5.047	.258
6	1.92	6.625	6.065	.28

SEAMLESS STEEL TUBING—Following net prices are for seamless mechanical tubing, cold drawn, round, .10 to .30 carbon, at New York warehouse in lots of less than 100 ft. or 100 lb.:

——Thickness—— Decimal	B.w.g. and Fractions	Outside Diameter in Inches ½	⅝	¾	⅞	1	1⅛	1¼
		Price per Foot						
.035"	20	$0.15	$0.16	$0.17	$0.18	$0.19	$0.21	$0.23
.049"	18	.17	.18	.19	.20	.21	.23	.25
.065"	16	.19	.20	.21	.22	.23	.25	.27
.083"	14	.20	.22	.23	.24	.25	.27	.29
.095"	13	.21	.23	.25	.26	.27	.29	.31
.109"	12	.22	.24	.26	.27	.28	.30	.32
.120" or .125"	11	.23	.25	.27	.28	.29	.31	.33
.134"	10	.24	.26	.28	.29	.30	.32	.34

MISCELLANEOUS—Warehouse base prices in cents per lb.:

	New York	Cleveland	Chicago
Spring steel, light*	4.50	4.65	4.65
Spring steel, heavier	4.00	4.00	4.00
Coppered Bessemer rods	6.05	6.00	6.20
Hoop steel	4.50‡	4.00	4.15
Cold rolled strip steel	6.25	6.00	6.10
Floor plates	5.10‡	5.30	5.00
Cold drawn, round or hexagon†	3.40	3.65	3.60
Cold drawn, flat or square†	3.90	4.15	4.10
Structural shapes	3.30‡	3.00	3.10
Soft steel bars	3.25‡	3.00	3.00
Soft steel bar shapes	3.25‡	3.00	3.00
Soft steel bands	4.00‡	3.65	3.65
Tank plates	3.30‡	3.00	3.10
Bar iron (2.75 at mill)	3.24	3.00	3.00
Drill rod (from list)	60%	55%	50%

*Flat, 3/16@½-in. thick. †Cold finished steel, shafting and screw stock. ‡250 to 3,999 lb., ordered and released for shipment at one time.

Electric welding wire, New York, 3/32, 8.35c.; ⅛, 7.85c.; 5/32 to ½ 7.35c. per lb.

METALS

Warehouse Prices in Cents Per Pound for Small Lots:

Copper, electrolytic, New York			15.00
Tin, straits, pigs, New York			57.00
Lead, pigs, E. St. Louis	6.00	New York	7.00
Zinc, slabs, E. St. Louis	5.75	New York	6.75

	New York	Cleveland	Chicago
Antimony, slabs	12.50	13.25	14.25
Copper sheets, base	23.00	23.00	22.75
Copper wire, base	19.50	19.62½	16½ (mill)
Copper bars, base	21.50	21.50	22.25
Copper tubing, base	24.50	24.50	24.50
Brass sheets, high, base	18.75	18.75	18.75
Brass tubing, high, base	23.62½	23.62½	23.62½
Brass rods, high, base	16.50	16.50	16.50
Brass wire, high, base	19.25	19.50	19.25

Shop Materials and Supplies

METALS—Continued

	New York	Cleveland	Chicago
Aluminum ingots, 99%.....	25@26*	22¾@24	24.30
Zinc sheets (casks).....	9@ 9½	10.75	10.36
Solder (½ and ½), (case lots).....	34.00	32.50	33@37
Babbitt metal, delivered, New York, cents per lb.:			
Genuine, highest grade.....			71.00
Commercial genuine, intermediate grade.....			57.00
Anti-friction metal, general service.....			31.50
No. 4 babbitt (f.o.b.).....			12.00
Nickel, f.o.b. refinery, cents per lb.:			
Ingots..... 35.00	Electrolytic.. 37.00	Shot.....	36.00

*Delivered.

SPECIAL NICKEL AND ALLOYS—Price in cents per lb., f.o.b. Huntington, W. Va.:

Full finished nickel sheet (base).....	52.00
Cold rolled nickel sheet (base).....	60.00
Hot rolled rods, Grade "A" (base).....	45.00
Cold drawn rods, Grade "A" (base).....	53.00

Base price of Monel metal in cents per lb., f.o.b. Huntington, W. Va.:

Shot.....	28.00	Hot rolled rods (base)...	35.00
Blocks.....	28.00	Cold drawn rods (base)..	43.00
Cold rolled sheets (base)	50.00	Full finished sheets (base)	42.00

OLD METALS—Dealers' purchasing prices in cents per pound:

	New York	Cleveland	Chicago
Crucible copper.....	12.37½@12.62½	11.50	11.25@11.75
Copper, heavy, and wire..	11.50 @12.37½	10.75	10.75@11.25
Copper, light, and bottoms	10.25 @10.75	9.50	9.50@10.00
Heavy lead.....	5.00 @ 5.25	5.25	4.25@ 4.75
Tea lead.....	3.75 @ 4.00	3.75	3.25@ 3.75
Brass, heavy, yellow.....	7.25 @ 7.50	7.25	7.00@ 7.50
Brass, heavy, red.....	9.25 @ 9.75	9.75	9.00@ 9.25
Brass, light.....	5.50 @ 6.00	5.75	6.00@ 6.50
No. 1 yellow rod turnings.	7.50 @ 8.00	7.50	7.00@ 7.50
Zinc.....	3.25 @ 3.50	3.25	2.50@ 3.00

TIN PLATES—Charcoal—Bright—Per box.

		New York	Cleveland	Chicago
"AAA" Grade:				
IC,	14x20.....	$12.10	$11.95	$11.50
"A" Grade:				
IC,	14x20.....	9.70	9.90	9.50
	Coke Plates—Primes—Per box			
100-lb.,	14x20.....	6.45	6.10	7.00
	Terne Plates—Small lots, 8-lb. Coating—Per box			
IC,	14x20.....	7.75@8.00	7.00	7.50

MISCELLANEOUS

	New York	Cleveland	Chicago
Cotton waste, white, per lb.‡	$0.10@0.13½	$0.16	$0.15
Cotton waste, colored, per lb.‡	.09@ .13	.12	.12
Wiping cloths, washed white, per lb.....	.15@.17½	38.00 per M	.15
Sal soda, per lb.....	.02	.02	.02¾
Roll sulphur, per lb.....	.027	.03½	.04
Linseed oil, raw, per 7½-lb. gal., 5 bbl. lots.....	.76½	.84	.78
Lard cutting oil, 25% lard, in 5 gal. cans, per gal....	.65	.60	.60
Machine oil, medium-bodied (55 gal. steel bbl.) per gal.....	.30	.36	.36
Belting—Present discounts from list in fair quantities (½ doz. rolls).			
Leather—List price, 24c. per lin.ft. per inch of width for single ply.			
Medium grade.....	35%	35%	35%
Heavy grade.....	30%	30%	30%
Rubber transmission, 6-in., 6 ply, $1.83 per lin.ft.			
First grade.....	45%	50–10%	50%*
Second grade.....	50%	60–5%	50–10%†

*Large quantities, 60%. †Large quantities, 60–10% ‡Bale lots.

Comparative Warehouse Prices

New York	Unit	Current Price	Four Weeks Ago	One Year Ago
Soft steel bars.....	per lb....	$0.0325	$0.0324	$0.0324
Cold drawn shafting....	per lb....	.034	.034	.04
Brass rods.....	per lb....	.165	.165	.1587½
Solder (½ and ½).....	per lb....	.34	.3325	.4175
Cotton waste, white....	per lb....	.10@.13½	.10@.13½	.10@.13½
Emery disks, cloth, No. 1, 6-in. dia.....	per 100...	3.10	3.10	3.10
Lard cutting oil.....	per gal...	.65	.65	.55
Machine oil.....	per gal...	.30	.30	.33
Belting, leather, medium.....	off list....	35%	35%	40–5%
Machine bolts, up to 1x30 in., full kegs....	off list....	50%*	50%*	50%*

*List prices as of April 1, 1927.

MISCELLANEOUS—Continued

	New York	Cleveland	Chicago
Abrasive materials—Standard grade, in sheets 9x11 in., No. 1, per ream of 480 sheets:			
*Flint paper.....	$5.40	$4.95	$5.13
*Emery paper.....	10.71	9.15	10.71
†Emery cloth.....	27.84	27.85	27.84
Emery disks, 6 in. dia., No. 1, per 100:			
Paper.....	1.29	1.27	1.32
Cloth.....	3.10	3.05	3.05
Fire clay, per 100 lb. bag.....	1.00	.75	.75
Coke, prompt furnace, per net ton...	Connellsville,		2.60@2.75
Coke, prompt foundry, per net ton...	Connellsville,		3.75@4.50
White lead, dry or in oil...	100 lb. kegs....	New York,	13.75
Red lead, dry.....	100 lb. kegs....	New York,	13.75
Red lead, in oil.....	100 lb. kegs....	New York,	15.25

*4½ reams and under. †Less than 2 reams.

SHOP SUPPLIES

Discounts from new list dated Apr. 1, 1927, applying on immediate deliveries from warehouse stocks in New York and vicinity:

	Full Kegs or Cases
Machine bolts, square heads and nuts:	
Up to ¾ x 6-in.....	55%
Larger up to 1 x 30-in.....	50%
1⅛ and 1¼ in. dia.....	35%
Carriage bolts:	
Up to ¾ x 6-in.....	55%
Larger sizes.....	50%
Coach and lag screws:	
Up to ¾ x 6-in.....	55%
Larger sizes.....	50%
Tap bolts, hexagonal heads.....	40%
Nuts:	
Hot pressed, square and hexagonal, blank or tapped, up to 1-in., incl.....	55%
Cold punched, square and hexagonal, blank or tapped, up to 1-in. incl.....	55%
Semi-finished, hexagonal, tapped, in packages, all sizes.....	40%
Case hardened, hexagonal, tapped, in packages, all sizes.....	30%
Washers: Deduct from list, per 100 lb.....	$3.50*
Rivets, button and cone head:	
Small, including ⅛-in dia.....	50–10%
Large (base) per 100 lb. net.....	$5.00†

Note—For less than case or keg quantities on bolts, screws, hot-pressed and cold-punched nuts, add extra of 10 per cent to list.
*Broken keg lots, $1.50 off list. †Broken keg lots, $6.50 net.

Machine Requirements and Industrial Construction

Equipment Wanted

La., New Orleans — U. S. Engineer Office—will receive bids until May 1, for two gasoline-driven 4 wheel outrigger cranes complete with equipment.

Mich., Lansing—Durant Motors Inc., Flint —machinery and equipment for proposed 1 and 2 story addition to motor car factory. Estimated cost $750,000.

N. J., Montclair—Bd. of Education, Administration Bldg., 2 Valley Rd., will receive bids until May 10 for manual training shop equipment, etc., for the year 1928 to 1929.

O., Athens—Artcraft Metal Works of the J. B. Grayson Mfg. Co., D. E. Williams, Mgr.—metal working equipment for the manufacture of porch lanterns, bronze and brass specialties, etc. for new shop.

Wash., Yakima—U. S. Indian Irrigation Service—will receive bids until May 2, for one manually operated 5 ton 17 ft. span crane.

Ont., London—Taylor Electric Co., Adelaide St.—machinery and equipment for the manufacture of electrical supplies, for proposed 1 story, 100 x 150 ft. addition to factory on Adelaide St. Estimated cost $50,000.

Ont., Welland — Bd. of Education, W. Lowe, Secy.—machinery and equipment including lathes, drills, woodworking equipment, etc. for proposed vocational school shops.

Opportunities for Future Business

Calif., Oakland—Bd. of Eduction is receiving bids for the construction of shop buildings for East Oakland high school. Estimated cost $70,000. Miller & Warnecke, 1401 Franklin St., Archts.

Ill., Chicago — American Can Co., 104 South Michigan Ave., awarded contract for a 3 story, 145 x 165 ft. factory at 6005-6025 South Western Ave. Estimated cost $230,000.

Ill., Chicago—V. Bendixen, 2300 Bloomingdale Ave., awarded contract for a 31 x 73 ft. addition to foundry. Estimated cost $20,000.

Ill., Chicago — Chicago Pump Co., 2336 Wolfram, St., awarded contract for addition to factory for the manufacture of house pumps for lifting water in buildings above 3 story in height.

Ill., Moline — Harrington-Seaberg Co. awarded contract for a 4 story, 62 x 135 ft. factory for the manufacture of police and fire alarm equipment, traffic signals and electric flashers. Estimated cost $75,000. A second unit covering 94 x 135 ft. will be built later.

Ind., Bloomington—Showers Bros., W. E. Showers, Pres., 601 Norton St., manufacturers of furniture, awarded contract for a 2 story, 60 x 150 ft. factory. Estimated cost $100,000.

Me., Bangor—F. M. Woodman, c/o V. Hidgins, 39 Hammond St., is receiving bids for a 2 story, 100 x 105 ft. repair and service garage on Center St., Archt.

Me., Portland — R. H. Rhines, Forest Ave. and Oak St., awarded contract for the construction of a 2 story, 90 x 150 ft. garage. Estimated cost $100,000.

Me., Waterville—Maine Central R.R. Co., 222-242 St. John St., Portland, awarded contract for the construction of a car shop and paint store, etc., here. Estimated cost $62,000. B. T. Wheeler, Ch. Engr.

Mass., Attleboro — G. A. Sweeney, 160 South Main St., is receiving bids for a 1 story, 100 x 120 ft. garage and repair shop on County St. Estimated cost $40,000. Private plans.

Mass., Billerica—A. W. Stearns, Boston Rd., is receiving bids for a 1 story, 60 x 75 and 35 x 80 ft. repair and service garage on Boston Rd. Estimated cost $40,000. Gay Proctor, 248 Boylston St., Boston, Archts.

Mass., Hyde Park (Boston P. O.)—Bay State Upholstering Co., 152 North St., Boston, awarded contract for a 3 story, 60 x 190 ft. plant on Business St., here. Estimated cost $60,000. M. Linenthal, 333 Washington St., Boston, Archt.

Mass., Quincy (Boston P. O.) — K. A. Karjalainen, 25 Greenwood Ave., awarded contract for a 2 story, 40 x 100 ft. auto repair shop. Estimated cost $40,000. Noted Apr. 12.

Mass., Springfield—Fort Realty Co., c/o H. C. Hearne, 1389 Main St., Archt., is having revised plans prepared for a 3 story, 110 x 140 ft. repair and service garage at Fort and Columbus Aves. and Hampden St. Former bids rejected. Noted Apr. 12.

Mass., Waltham (Boston P. O.)—T. Sullivan, 635 Main St., awarded contract for a 2 story, 60 x 100 ft. repair and service garage on Main St. Estimated cost $50,000.

Mich., Detroit—The White Motor Co., T. R. Dahl, Secy., 842 East 79th St., Cleveland, O., had plans prepared for a 1 story, 189 x 204 ft. sales and service station on 12th St. here. Estimated cost $150,000. Hadlow, Hughes, Hick & Conrad, Union Mortgage Bldg., Archts.

Minn., Minneapolis — The Dayton Co., G. D. Dayton, Pres., awarded contract for a 4 story garage at Eighth St. and La Salle Ave. Noted Mar. 15.

Minn., St. Paul—L. W. Jordan Co. will build a 1 story repair and service garage at Fourth St. and Main Ave. Estimated cost $50,000. Architect not selected.

Minn., Two Harbors — A. Sonju and M. Olson awarded contract for a 1 story, 65 x 120 ft. repair ad service garage. Estimated cost $30,000.

Neb., Lincoln—H. C. Young, 3311 North St., awarded contract for a 2 story, 115 x 120 ft. repair and service garage at 33rd and O Sts. Meginnis & Schaumberg, 614 Federal Trust Bldg., Archts.

N. J., Camden—Standard Tank & Seat Co., awarded contract for a 3 story, 32 x 78 ft. addition to factory at 314 North Front St.

N. J., Newark—Art Metal Works, 7 Mulberry St., is having plans prepared for a 2 story addition to factory at Mulberry and Division Sts. Estimated cost $40,000. H. Baechlin, 665 Broad St., Archt. Noted Mar. 29.

N. J., Irvington—Forstner Chain Corp., 646 Nye Ave., awarded contract for a 3 story, 60 x 120 and 30 x 80 ft. addition to factory at 646-644 Nye Ave. Estimated cost $60,000.

N. J., Newark—Syndicate, c/o Spaulding Frazer, 24 Commerce St., plans the construction of an 8 story, 175 x 199 ft. garage at Washington and Warren Sts. Estimated cost $1,150,000. Architect not announced.

N. Y., Brooklyn—M. E. Pellegrine, 2148 Ocean Ave., had plans prepared for a 100 x 100 ft. service garage, etc. at Ocean Ave. and Ave. Y. Estimated cost $78,000. I. H. Lanzaione, 60 Jefferson St., Archt.

N. Y., Brooklyn—D. Welsch, 20-46 Hewes St., will build a 1 story garage at 43-47 Emerson Ave. Estimated cost $60,000. H. J. Nurick, 44 Court St., Archt. Noted Mar. 8.

N. Y., New York—Cyclops Co. Inc., 355 East 149th St., will build a garage at White Plains Ave. and Wilgus St. C. Kreymborg, 2534 Marion Ave., Archt. Noted Apr. 12.

N. Y., New York—H. Hackary, 510 East 82nd St., had plans prepared for a 2 story, 110 x 122 ft. garage and storage building at Concord Ave. and 144th St. Estimated cost $40,000. J. Fisher, 45 Astor Pl., Archt.

N. Y., New York—L. Naham, 239 Canal St., had plans prepared for a 2 story, 100 x 121 ft. garage at White Plains Rd. and 213th St. Estimated cost $100,000. Cohen & Siegel, 45 West 57th St., Archts.

N. Y., New York — New York, New Haven & Hartford R.R. Co., Grand Central Terminal, awarded contract for a 106 x 376 ft. extension to Van Nest shops. Estimated cost $250,000.

N. Y., New York—O. Reimer, 65 West 183rd St., had plans prepared for a 2 story, 109 x 120 ft. service garage at Tremont and Cedar Sts. Estimated cost $85,000. De Rose & Cavalieri, 370 East 149th St., Archts.

N. D., Bismarck —, International Harvester Co. of America, 606 Michigan Ave., Chicago, is having plans prepared for a 1 story, 100 x 130 ft. sales and service station here. Estimated cost $50,000. W. D. Price, Supt. of Construction.

O., Cleveland—The U. S. Air Compressor Co., 5300 Harvard Ave., had plans prepared for a 1 story, 141 x 151 ft. addition to factory. Estimated cost $50,000. G. S. Rider Co., Century Bldg., Archt.

Pa., Neville Island (Pittsburgh P. O.) — Dravo Contracting Co. will build a 1 story, 100 x 142 ft. addition to plant. Estimated cost $40,000.

Pa., Norristown—Bridgeport Iron Works, W. R. Browne, 1538 Powell St., awarded contract for a 1 story, 95 x 200 ft. foundry at Church and Crookline Rd., Upper Merion. Estimated cost $75,000.

Pa., Philadelphia—Acme Coppersmiths & Machinery Co., J. Epstein, 1024 Ridge Ave., will build a 4 story, 109 x 240 ft. factory at Berks and Hancock Sts. Private plans.

Pa., Philadelphia—E. H. Reuss, Jr., 30th and Race Sts., (heating contractors) awarded contract for a 2 story, 50 x 347 ft. shop, etc. at 49th and Grays Ave. Noted Apr. 5.

Pa., Pittsburgh—Miller Saw Trimmer Co. will soon award contract for 1 and 2 story, 261 x 293 ft. factory. Estimated cost $300,000. Hunting, Davis & Dunnells, Century Bldg., Archts.

Tenn., Athens—Sani-Fold Corp., E. E. Sutherland, Pres., has acquired a 14 acre site and plans the construction of a 2 story, 62 x 152 ft. factory for the manufacture of folding furniture, poultry coops and small furniture pieces, show cases, tables, hampers, porch furniture, etc.

Tenn., Ducktown—The Ducktown Copper & Iron Co., is reported to be planning to rebuild machine and carpenter shops recently destroyed by fire. Estimated cost $25,000.

Tex., Houston—Oil Center Tool Co., A. J. Penick, 1111 East 21 St., Mgr., manufacturers of oil well machinery, tools, etc. plans the construction of an additional unit to plant to increase the capacity.

Tex., San Angelo — Gulf, Colorado & Santa Fe Ry. Co., Galveston, will build a freight depot and round house here. Estimated cost $375,000. F. Merritt, Ch. Engr.

Wis., Milwaukee—Argo Investment Co., 123 Wisconsin Ave., awarded contract for a 6 story, 100 x 151 ft. garage at 5th and Michigan Sts. Estimated cost $300,000. Noted Mar. 29.

Wis., Milwaukee—H. Heyer & Son, 401 Reed St. is receiving bids for a 4 story, 50 x 130 ft. factory for the manufacture of furniture, on Reed St. Velguth & Papenthien, 141 East Wisconsin Ave., Archts.

Ont., Hamilton—Toronto Hamilton Buffalo Railway, is having plans prepared for locomotive repair shops, round house, etc. Estimated cost $1,000,000. H. T. Malcolmson, Engr.

Ont., Toronto—A. D. Garrie & Co. Ltd., 354 Victoria St., is having plans prepared for a 2 story, 104 x 200 ft. garage at 2420 Yonge St. Estimated cost $200,000. M. Brown, Confederation Life Bldg., Archt.

Ont., Windsor—Canadian National Railways, Montreal, Que., C. S. Gzowski, Ch. Engr. and Wabash Ry. Co., Exchange Bldg., St. Louis, Mo., R. H. Howard, Ch. Engr., plan the construction of yards and extensive machine shops, etc., here. Estimated cost approximately $1,000,000.